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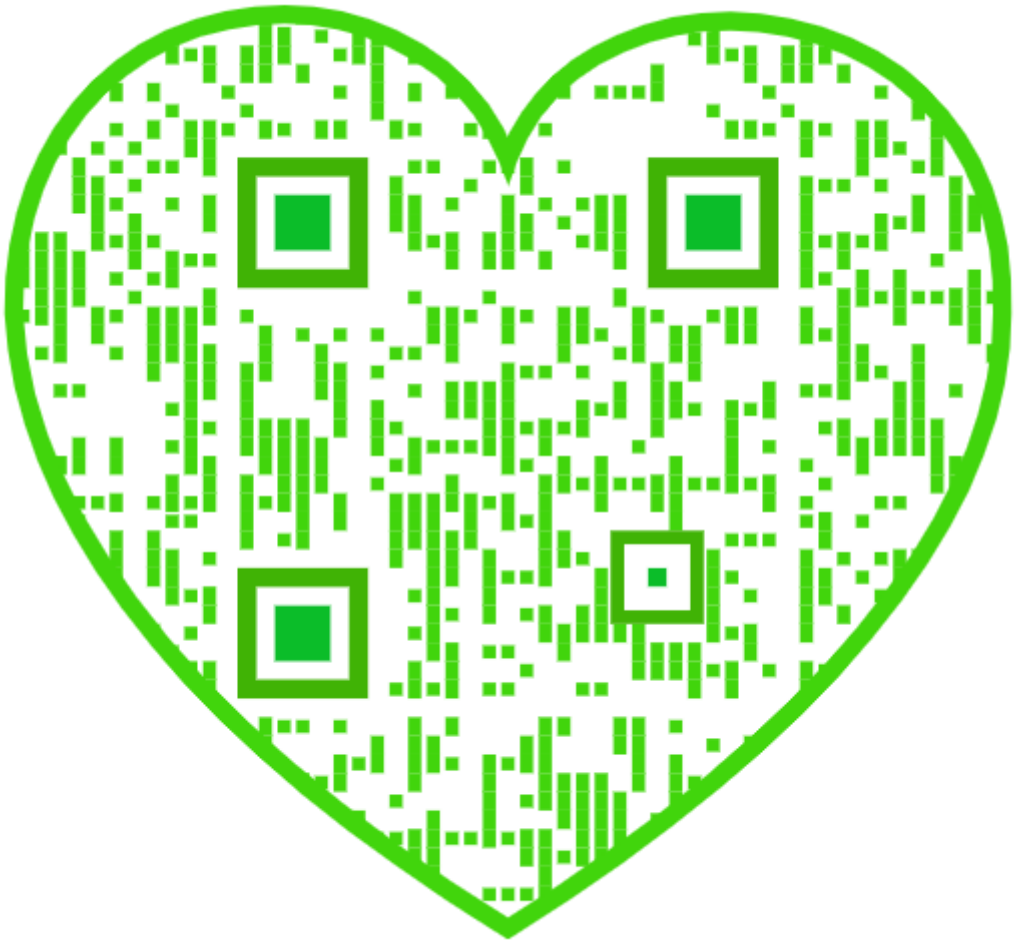

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FINAL REPORT

SSI NO. 27

MOVEMENT AND SHELTER OPTIONS TO REDUCE POPULATION VULNERABILITY

OCD CONTRACT NO. DAHC20-69-C-0139
WORK UNIT 2313-B

This report has been reviewed in the Office of Civil Defense and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense.

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FINAL REPORT SUMMARY

MOVEMENT AND SHELTER OPTIONS TO REDUCE POPULATION VULNERABILITY

CONTRACT DAHC20-69-C-0139
OCD WORK UNIT 2313-B

PREPARED FOR
OFFICE OF CIVIL DEFENSE
OFFICE OF THE SECRETARY OF THE ARMY
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

BY

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This report has been reviewed in the Office of Civil Defense and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense.

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SUMMARY

The purpose of this study is to develop planning options featuring a combination of dispersal and shelter tactics believed to be potentially more effective for reducing casualties in a population at risk during a massive nuclear attack, than present and previous evacuation and shelter combinations. The options contemplated are designed to be advantageous, during an international crisis of indeterminate length, for urban residents in areas of high blast hazards. They include provisions for the continuation and even extension of essential production.

In the past, long term civil defense program responses have changed to accommodate the threat while being constrained by budget changes. Blast shelters were proposed but were never funded. "Survival Planning" based on evacuation, once popular, was abandoned in favor of a nationwide fallout shelter development. The National Fallout Shelter Survey was successfully carried out and was followed by the present Community Shelter Planning Program (CSP).

The detailed and well directed surveys have been extremely successful in identifying more spaces than anticipated. Also, OCD Research has been successful in developing the technical basis for more intensive use of basement spaces for blast protection, expedient shelter potential, and planning for resource utilization.

In the past decade civil defense planning parameters and expectations have continued to change. Now we might expect days or weeks of possible strategic warning. Widely distributed, high quality fallout shelters, including those in home basements have been located, most of them in or near central cities and both the blast shelter program and the ABM defense for population have been deferred indefinitely.

In case of a nuclear attack, the present plan calls for the population to take refuge in fallout shelters making use of all "available protection with maximum effectiveness." This could increase population vulnerability to blast and fire, since the shelters are neither designed nor intended for protection against these effects. As an alternative plan, combinations of

dispersal-shelter options could provide the solution, in view of past OCD research studies which indicated that:

1. Resources are available to relocate the US urban population in a "crisis" context.

2. The relocated urban population can be accommodated in rural or smaller urban areas while intensive use of homes convenient to major highways and numerous transportation resources can facilitate commuting of essential workers.

3. The housing load ratios resulting from such relocation do not exceed those currently prevailing in peacetime, in Czechoslovakia, Finland, and the USSR.

4. The protection available under past city programs (NFSS, HFPS spaces, plus expedient fallout shelters) appear as feasible solutions to meet the "crisis" fallout shelter needs of both "hosts" and evacuees.

5. Because significant fractions of industrial capacity are already located outside of metropolitan areas and this capacity is usually used to to only one half of its potential, restrictions on outputs could be limited.

With all these favorable factors present, combinations of dispersal and shelter options were investigated and estimates of casualties were made. One of them shows that with a PF 20 in rural fallout shelter and a 75 percent level of dispersal, as much as 40 percent or nearly 50 million of the preattack population at risk could be saved. The same result could have been obtained with special urban blast shelters but at a much higher cost.

To give an idea of the cost and assuming a program of dispersal complementary to CSP with a 50 percent budget increase for the CSP cost, the following budget would be required: (1) Planning and other costs of computer assisted analyses to determine risk and dispersal areas, the latter with fallout shelters plus computer planning with maps for one urban and dispersal area with on-site assistance: $550,000.00, (2) pre-crisis costs, in addition to an OCD yearly budget of 75 million would amount to 50 million per year to which 10 million is recommended for blast and fire slanting research, or a total of 135 million per year, and (3) should a crisis occur and civil defense makes use of the dispersal shelter option, a budget of 500 to 775 millions would be required as an original response.

The total of these costs is low when compared to the 50 million lives saved under this dispersal-shelter option.

In summary, a dispersal-shelter option is extremely effective in reducing casualties; past studies have shown that it is feasible and that the costs of implementation are low considering the results in reduction of casualties. The study recommends that this option be implemented not as a totally new program but as an extension of the CSP program.

FINAL REPORT

SSI NO. 27

Movement and Shelter Options

to

Reduce Population Vulnerability

Prepared for

Office of Civil Defense
Office of Secretary of the Army
Department of the Army
Washington, D. C. 20310

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PREFACE AND ACKNOWLEDGEMENT

This report includes a review of civil defense programs featuring movement and shelter. Extensive reliance was placed on preceding research and analyses. For published works, appropriate citations have been made. Memoranda, staff evaluations, and other materials of limited distribution were of critical importance. Within OCD, Mr. Lawrence Bearnes of Plans and Operations, OCD: and Mr. Joseph S. Glick of Policy and Programs, OCD: and outside OCD, Mr. Fielding Huesman of Department of Housing and Urban Development, and Dr. James C. Pettee, National Resources Analysis Center, OEP, were especially helpful in providing materials and making suggestions based on their direct experiences.

The concepts for the calculations showing different degrees of dispersal, and the programming associated therewith, were originated by Mr. Miles Letts of System Sciences, Inc. Dr. Charles Anderson provided the analysis of emergency medical care capabilities. Mr. Joseph Romm aided in reviewing the manuscript and in the preparation of budget estimates for preparedness under crisis conditions.

The report benefits greatly from concepts advanced by the Director of Research, OCD, Mr. Walmer E. Strope, during the Civil Defense Symposium of October 1968 and on other occasions.

Special acknowledgement is given to the Contract Officer's Technical Representative, Mr. George C. Van den Berghe, whose assistance varied from facilitating the use of the National Civil Defense Computer Facility to suggestions as to technical methodology and final editing of the report.

ABSTRACT

This report concerns more efficient movement and shelter responses necessary to meet national and local civil defense planning responsibilities. The effectiveness of the present fallout shelter program and alternatives is estimated. Using the DASH computer program, modified, casualties are calculated from a spectrum ranging from (a) urban blast shelter construction, and no outward movement, to (b) 75 percent evacuation of urban areas. Radical changes in the scope and extent of the enemy threat are considered, as well as the variations in financial support from the Congress, and the fundamental strategic military decisions that place higher priority on military capabilities. The influence of U.S.S.R. crisis evacuation planning is included. The reactions of civil defense to these influences are traced in varying program emphases on movement and shelter. An analysis is presented as to why, how, and at what cost (single and five-year budgets) some urban areas may be selected for the purpose of providing a local planning option to disperse urban populations, in a national pre-attack crisis context of unpredictable duration, while maintaining essential production, and featuring commuting of essential labor force concurrent with expedient fallout shelter construction for the dispersed population in "host" areas.

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SCOPE OF WORK

The work reported herein is part of a special effort to provide civil defense with alternative countermeasures to be used either in areas where shelter spaces are deficient or if not where their use might be dangerous for the occupants. The scope of work of the contract reads as follows:

1. Evaluate the various procedures applied in executing past civil defense planning measures, including an analysis of the costs and time required to design, schedule, and prepare the various plans.

2. Based upon the findings of the above evaluation and an evaluation of current planning processes as they have evolved for a more responsive civil defense capability, define, describe and analyze suitable procedures with feasible alternatives, for obtaining MTS plans for a sample of SMSA's. The sample shall be selected in consultation with the Government. In selecting communities for which MTS planning procedures are to be considered, attention shall be devoted to geophysical, demographic, socio-economic and jurisdictional factors.

3. Submit a final report for the analytical study, giving an evaluation of, and recommended procedures for, the development of a feasible MTS option.

The findings presented here are the product of the work done under this scope of work.

Chapter 1

Movement and Shelter Evolvements

This report is concerned with a mixture of movement and shelter tactics believed more effective in saving lives than previous movement-shelter combinations. Conceptually, it is a direct extension of technology and knowledge developed from civil defense experiences of the last decade. Its objective is to advance the state-of-the-art in exploiting movement and shelter alternatives within a dynamic environment that assigns an ever lower priority to the civil defense program in essential budgetary aspects.

Combinations of movement and shelter to protect population have been common responses of officials charged with civil defense responsibilities since before World War II, both in this country and abroad. In the determination of a desirable combination of movement and shelter, many features must be considered. Among the factors are (a) the time assumed or estimated as available for movement, (b) the quality of shelter available or attainable within the relevant time spectrum, (c) the nature and magnitude of the threat, (d) cost, measured in monetary and other units, and (e) effectiveness, measured in fatalities, casualties, and other units.

The World War II experiences in Great Britain are illustrative of strategic movement and tactical shelter extremes. In three days, beginning September 1, 1939, some 1,473,000 children, mothers, expectant mothers, blind persons, and teachers and associated helpers were evacuated from urban to rural areas, under government guidance and control. Coincident with the Battle of Britain in the Fall of 1940, a second evacuation was initiated. It involved many of the same individuals who had returned to their homes in the meantime.

With the decrease in air attacks following the Battle of Britain, a significant number of the evacuees again returned to their homes. A third evacuation took place in 1944, first in response to the V-1 attacks and several months later the V-2 attacks, but the third evacuation was

less extensive than the first two. Those who did not, or could not, evacuate utilized the minutes afforded by tactical warning to take refuge in subways, improvised protective construction, and especially constructed shelters.

Similar combinations of movement and shelter were utilized by the Germans, the Russians, and the Japanese.[1/]

The availability of nuclear weapons, and the later thousand-fold increase of their destructive force into megatonnage yields, has not outmoded the livesaving value of movement and shelter as feasible Civil Defense combined reactions. The 1945-46 reports of the United States Strategic Bombing Survey included recommendations for a national organization to prepare the United States' plans for contending with the threat of nuclear weapons. Two complementary plans and programs were recommended:

1) Evacuation of unnecessary inhabitants from threatened urban areas; and

2) Rapid erection of adequate shelters for people who must remain.[2/]

The statutory definition of civil defense continues to recognize the validity of these responses to the threat in the following language:

> "... the construction or preparation of shelters, shelter areas, and control centers; and when appropriate, the non-military evacuation of civil population ...."

The operational planning of 1970 under the basic Civil Defense statute, Public Law 920, the Federal Civil Defense Act of 1950,[3/]

1/ A convenient and critical summary of the experience of these countries in various forms of strategic and tactical evacuation is contained in Appendix A, "Some World War II Examples of Evacuation," from Strategic and Tactical Aspects of Civil Defense with Special Emphasis on Crisis Situations, W. M. Brown, Hudson Institute, Final Report, January 7, 1963.

2/ The United States Strategic Bombing Survey, The Effects of Atomic Bombs on Hiroshima and Nagasaki, June 30, 1946, pp. 36-38. Also, see commentary on "Lessons of Hiroshima and Nagasaki," as reported in New Civil Defense Program, Ninth Report by the Committee on Government Operations, 87th Cong., 1st sess., House Report No. 1249, September 21, 1961, pp. 37-39.

3/ Under this statute, the responsibilities associated with movement and shelter were vested in the Federal Civil Defense Administration until 1958; but then transferred to Office of Civil and Defense Mobilization; and transferred again in 1961 to Department of Defense.

signed by the President, January 12, 1951, and from which the above language was extracted, thus continues to be fundamentally consistent with that twenty-year old definition of civil defense. The problem is not simple. Critical factors have changed over the years. The threat persists, although the weapons, their specific effects, and the enemy identity may change.

The inseparable concepts of movement and shelter are frequently distorted by civil defense programs that are arbitrarily labeled as either a "shelter" program or an "evacuation" program. A brief review of selected portions of the evolution of present civil defense planning helps to understand consistencies not readily evident from seemingly contradictory program labels, such as "shelter" and "evacuation." Civil defense opponents rely on such labels, and apparent inconsistencies, to justify opposition to all expenditures.

For three fiscal years concurrent with its establishment early in the Korean War, the Federal Civil Defense Administration developed various shelter construction plans, and duly presented them to the Congress. The total budget requests varied from $403 million in FY 1951 to $601 million in FY 1953.[4/] The Congress slashed the request by percentages ranging from 86 percent to 93 percent. The shelter emphasis and plans were entirely consistent with the basic statute. Public Law 920 contemplated fifty year loans up to $250 million for the purpose of aiding civil defense projects. The authorization continues in the present statute.

Confronted with a lack of shelters in-being, essentially no construction fund appropriations (as distinct from authorizations), an inadequate warning system, and a general scarcity of materials brought on by the need for immediate war-goods production necessitated to prosecute the Korean War, the FCDA implemented an expedient program consisting of the following main elements:

4/ A Digest of Selected Financial and Workload Data as of 30 June, Fiscal Year 1951-1968, Department of Defense, Office of Civil Defense, September 1969, p. 2.

1) Surveys of "Target Cities" to identify existing buildings which were suitable for shelter.

2) Minor alterations, where appropriate, to make additional buildings suitable for shelter.

3) Technical assistance by FCDA for the building of a limited number of group shelters in those areas where skilled industrial personnel have no shelter in case of attack.

That "shelter" program was formulated before the development of thermonuclear weapons and capabilities, and the widespread recognition of the fallout hazard. The program is remarkable for its comparability with that of the early 1960's, with its overriding emphasis on protection against fallout.

The Protective Facilities and Construction Program for the Federal Civil Defense Administration for the years 1951, 1952, and 1953 are summarized in the "Holifield" hearings.[5/] The recommended shelter space allowance was six square feet per person at an estimated average cost of approximately $15 per square foot of new construction; for improvements to existing buildings, an average of $6.67 per square foot was estimated for major improvements; and $1.67 per square foot for minor improvements. For the necessary building surveys, FCDA estimated $6.5 million, with an equivalent $6.5 million to be provided by the states. The funds necessary to implement this program were not made available by the Congress.

In 1953, a new FCDA Administrator, Gov. Val Peterson, was appointed. He expressed no confidence in the shelter approach. In his judgment, "the vast improvement in the destructive power of nuclear weapons would turn such public shelters into death traps in the large cities."

Concurrent with this evaluation and its program implications, plus the expectation that the Distant Early Warning (DEW) line would be able to provide warning time measured in hours, FCDA shifted its emphasis from

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5/ Civil Defense for National Survival, Part 4, hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 84th Cong., 2d sess., April 10, 11, 12, 17, 19, May 15, 17, and 18, 1956, pp. 1254-1260.

"shelter" to "evacuation." Official "assumptions for dispersal planning" were issued indicating that as much as four hours warning time would be available by July 1, 1956. Planning guidances were issued March 7, 1955, and July 20, 1955, which, among other factors, listed anticipated warning time for selected cities in the United States. These warning times varied from 3-1/2 hours for Seattle to 6-3/4 hours for Norfolk, Virginia.6/

An annual FCDA document listed key civil defense planning assumptions. These assumptions were prepared in the closest feasible coordination with other agencies of government, especially the Department of Defense. The FCDA planning assumptions for FY 1956, issued May 12, 1955, identified probable target objectives within the United States as follows:

> "It is assumed that concentrations of population and industry and bases of military retaliation will be primary targets for nuclear attack."7/

The subject of shelter requirements was covered under a heading, "Dispersal of People."

> "It is assumed that radioactive fallout will affect the operating details of the evacuation policy. It will also require areas outside the target complex to develop shelter plans and possible evacuation measures...
>
> "Although the primary objective is to move people out of the areas of probable blast and thermal damage and immediate radiological effects, the possibility of radioactive fallout now makes it desirable to develop a high degree of flexibility in evacuation operations. Alternatively, provision should be made for sheltering people in areas where evacuation is not feasible." 8/

6/ See Civil Defense for National Survival, Part 6, hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 84th Cong., 2d sess., May 24, 25 , 28, 29, and 31, 1956, p. 2497, for a reproduction of the releases, and specific warning times for other cities.

7/ Civil Defense for National Survival, Part 1, hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 84th Cong., 2d sess., January 31, February 1, 7, 8, and 9, 1956, p. 251.

8/ Ibid., p. 252.

Concurrent with the gradual shift from shelter emphasis to evacuation, or dispersal planning emphasis, was a significant increase in the weapon effects threat. On March 1, 1954, the United States tested a thermonuclear device at Bikini Atoll. That detonation, on the surface of a coral island, caused significant contamination by fallout over an area of about 7,000 square miles. Caught in the danger area created by unanticipated wind changes were some 250 persons, including native Marshallese, a small number of American servicemen, and a boatload of Japanese fishermen. Fragmentary information concerning fallout, fire, and blast implications of the new device was publicly released by the Atomic Energy Commission during the balance of 1954. The first comprehensive unclassified news release on fallout and the thermonuclear weapon was issued in February 1955.

The thermonuclear weapon drastically increased the area of significant blast and overpressure effects. Planning that had been based on a nominal yield of 20,000 tons of TNT and significant overpressures extending for a radius of two miles, now had to be changed to contend with a typical yield of 20 million tons of TNT equivalent, and significant overpressures extending for a radius of 20 miles from ground zero.

The additional and extensive downwind threat of fallout did not stop the program of evacuation and dispersal planning initiated in 1954. It did cause extensive controversy and debate. Interest of key members of the Congress was especially keen. Doubt was expressed as to whether the "target areas" could be evacuated within the warning time afforded by the DEW line; and if this capability could be realized, whether it would result only in exposing the evacuated population to lethal fallout. An additional complication of the controversy was whether the Federal government or the state or local governments should have primary responsibility for civil defense.

To meet systematically the obvious need for a more comprehensive civil defense response, federal funds were requested for a program of "Survival Planning." The limited experience of those years had shown that coordinated city and rural planning, within a State, for a subject as technical, comprehensive, and bewildering as civil defense, would only be accomplished by supplying some form of outside assistance. With

these funds, and under federal technical guidance, each state prepared a "Survival Plan." In addition to yielding a survival plan, produced essentially by personnel within each state, and under the detailed direction of state civil defense authorities, the funds provided a bonus in the form of substantial upgrading of state planning competence. The training, indoctrination, and review provided by federal authorities was extremely helpful in educating federal, state, and local planners to the nature of the threat, and the effectiveness of the civil defense response.

Over four years were expended by the states in producing state survival plans. The expenditures averaged about $.08 per capita, and were obligated annually as shown below.

Year Ending June 30	"Survival Planning" Obligations
1956	$ 1,454,328
1957	5,767,241
1958	5,367,544
1959	1,100,940
Total	$13,690,053

Source: Department of Defense, Office of Civil Defense, A Digest of Selected Financial and Workload Data as of 30 June, Fiscal Year 1951-1968, compiled by Budget Division, Office of the Comptrolier.

Because these plans featured evacuation, as a first step, they were characterized as evacuation plans. Emphasis was placed on "saving" urban population first from blast effects on the common sense ground that the later fallout hazard was of secondary importance. Protection against fallout would be obtained somehow, it was hoped, and study and planning efforts were

emphasized to assess local area trade-offs between evacuation and no evacuation, and the availability of shelter under differing movement conditions.

By the end of FY 1961, every state, Puerto Rico, and the District of Columbia had operational survival plans. The work had been continued beyond FY 1959 without special program funding. Further, there were 738 separate counties with a civil defense director, a plan published and state approved, an active training program, a staff appointed and on record with the state, and significant civil defense planning and organizational activity. An additional 950 counties had a full or part-time civil defense director and a plan published and state approved. Fifty-four percent of the counties in the United States had at least a minimum capability; but the balance of 1,414 counties had little or no civil defense activity.[9/]

Concurrent with the development of state survival plans which featured evacuation and dispersal, to contend with blast and fire effects, there was being developed within the Planning and Research staff of OCDM a variety of different blast and fallout shelter plans. Revolutionary military technology typified by the intercontinental ballistic missile (ICBM), submarine launched ballistic or unmanned weapons, decreased warning times, and anti-ballistic missile concepts were critical elements of such plans, and required close inter-agency coordination. The plans were not made directly available to the public at large because of national security implications, and pending inter-agency coordination and education at the federal level.

One such plan was submitted to President Eisenhower on December 21, 1956. In the Spring of 1958, Mr. Gerald Gallagher, then OCDM Director of Research and Development, described the plan to the Committee on Government Operations, U.S. House of Representatives (Holifield Committee) as "essentially a combination of 30 pounds per square inch blast shelters and fallout shelters."[10/]

9/ 1961 Annual Report, Executive Office of the President, Office of Civil and Defense Mobilization, p. 6.

10/ Civil Defense, Committee on Government Operations, U.S. House of Representatives, 85th Cong., 2d sess., April-May, 1958, p. 99.

Subsequent to the 1956 presentation to President Eisenhower, the shelter construction plan was referred to the National Security Council. It became an "input" to the Gaither Committee, designated by President Eisenhower to study civil defense in the broad context of active and passive defense strategy. The Gaither report has yet to be released; nevertheless it is commonly known that the group endorsed a civil defense shelter program.[11/]

In May of 1958, a "National Shelter Policy" was announced by a newly-appointed Administrator, Governor Leo A. Hoegh. The policy is identical in many respects with the general program of 1969. Governor Hoegh listed five courses the Administration proposed to follow to develop a national shelter program. These were, in summary:

1) Inform the American people of the possible effects of nuclear attack;
2) Survey existing structures in major cities to determine fallout protection available;
3) Accelerate research on incorporating shelters in existing and new structures;
4) Construct a limited number of prototype shelters which will have practical peacetime uses;
5) Provide leadership and example of incorporating fallout shelters in new federal buildings designed for civilian use.[12/]

Pilot shelter surveys were undertaken in four areas: Tulsa, Oklahoma; Montgomery, Alabama; Milwaukee, Wisconsin; and part of Contra Costa County, California. Adequate shelter space was defined as 12 square feet per person

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11/ New Civil Defense Program, Ninth Report by the Committee on Government Operations, p. 44.

12/ Civil Defense Shelter Policy in Postattack Recovery Planning, 21st Report of the Committee on Government Operations, H.R. 2069, 86th Cong., 2d sess., July 1, 1960, p. 6.

in an area providing a fallout protection factor of at least 100. The surveys were conducted by private contractors, using the Government's "Guide for Fallout Shelter Surveys." From these surveys and possible other sources, Governor Hoegh estimated that he had sufficient information available to make the estimate that over 25 percent of the U.S. population could be accommodated by existing shelter spaces. In reviewing this estimate, the Committee on Government Operations, in its July 1, 1960, report, listed the results of the pilot surveys. The report went on to observe that if these results were the basis for Governor Hoegh's "25 percent" estimate they "fall far short of a realistic representation of existing conditions,"[13/] and that,

> "Governor Hoegh's oft-repeated estimate that 25 percent of the U.S. population can be sheltered in existing structures is not borne out by the pilot surveys, on which he stated his estimate was based."[14/]

To continue the survey program, and as followup to the pilot survey, civil defense authorities (OCDM) requested $700,000 in FY 1961 funds with which to complete a one-city survey in each state. An additional $500,000 was contemplated to be requested in the year 1962.

It is noted that the shelter survey data to be obtained by this 1960 procedure was far less detailed and sensitive than that conducted in 1962 by the Department of Defense in its National Fallout Shelter Survey (NFSS). The 1960 estimates were crude, by DOD standards of 1969. Structures were to be classified into six gross categories determined by the degree of estimated fallout protection estimated as follows:[15/]

13/ Ibid., pp. 13 and 14.

14/ Ibid., p. 15.

15/ Ibid., p. 14.

	Protection Factor
Category A	1,000 or greater
Category B	250 to 1,000
Category C	50 to 250
Category D	10 to 50
Category E	2 to 10
Category F	1-1/2 to 2

The protection factor (PF 100) identified as acceptable fallout shelter by Governor Hoegh is within the range of Category C's classification, PF 50 to 250.

Despite the skepticism of the Committee on Government Operations, Governor Hoegh's optimism and estimate has appeared to be extremely well-founded. Instead of the approximately 50 million fallout shelter survey spaces suggested by his 25 percent "unrealistic" estimate, almost four times that number have been located, as of January 31, 1969.

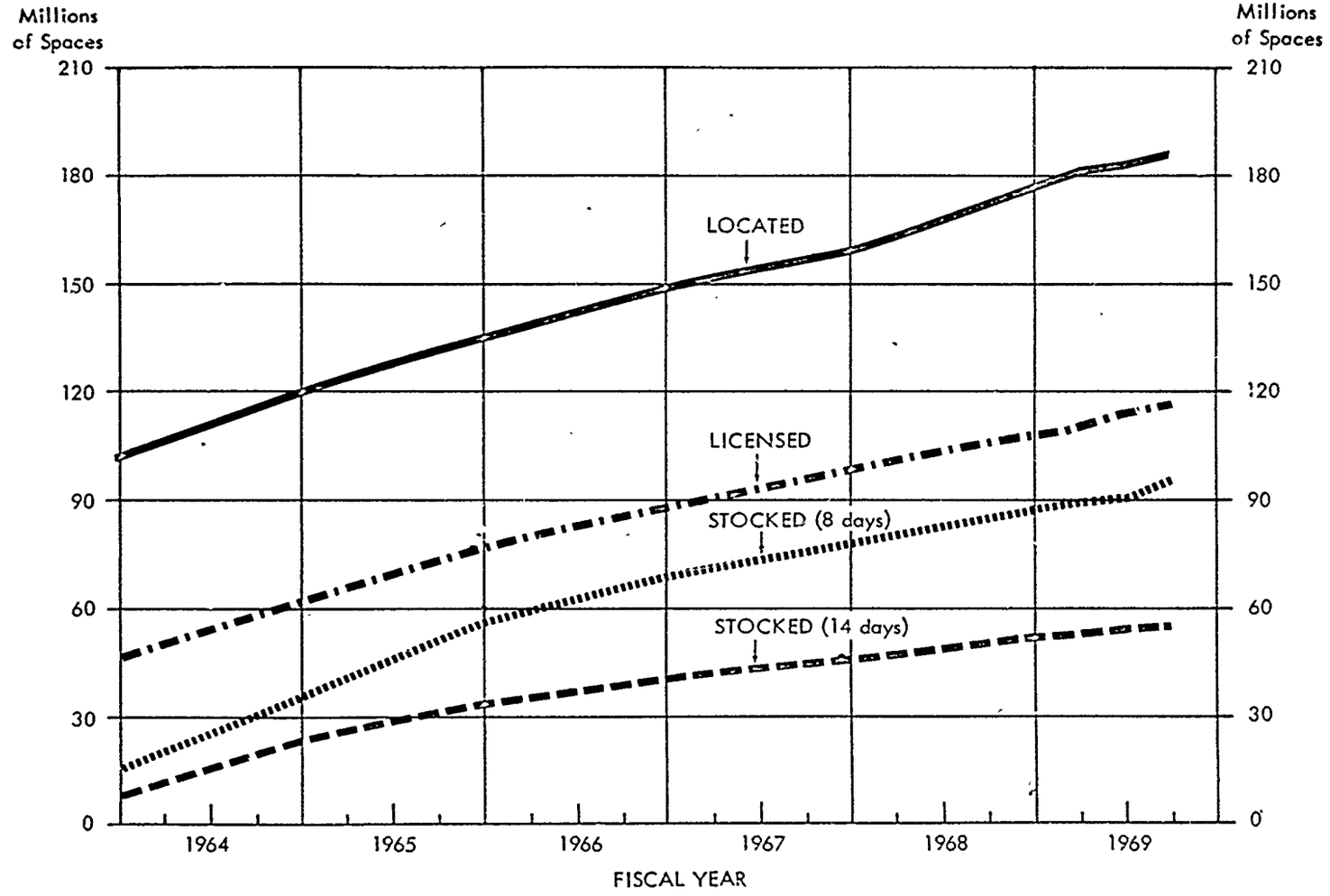
The National Fallout Shelter Survey program, initiated by the Department of Defense in late 1961, at first called for a protection factor of 100, but was later reduced to 40 or better, while Governor Hoegh's program called for a PF of 100 or better. Despite this difference in protection factors, the detailed NFSS data obtained during the 1962-1969 years have continued to show far more fallout shelter space than estimated or anticipated.

Without known exception, every significant well-funded civil defense survey or investigation (NFSS, State Survival Plans, trapped water, home fallout protection surveys--"HFPS") has yielded more resources in-being than pre-survey crude estimates and even pilot studies would suggest.

The following chart, "Cumulative Trend in NFSS Spaces Located, Licensed and Stocked as of March 25, 1969," illustrates the progress and present status of the NFSS program.

Comparison of spaces to total survey expenditures indicates that through fiscal year 1966, the approximately 150 million spaces surveyed and marked cost a total of slightly over $90 million, or an average cost of about $.60 per marked fallout shelter space. In fiscal years 1967

Chart 1. Cumulative Trend in Spaces Located, Licensed and Stocked



Source: Department of Defense, Office of Civil Defense, "Selected Statistics on the Fallout Shelter Program," OCD Statistical Report 7720.75, March 25, 1969, p. 11.

through 1969 inclusive, the approximately $32 million spent in shelter survey and marking has yielded about 35 million spaces, or a cost approaching that of about $1 per marked space. Table 1, "NFSS Survey and Marking Expenditures, Actual and Estimated, FY 1960-1970," follows.

Table 1

NFSS Survey and Marking Expenditures
Actual and Estimated
FY 1960-1970

Year	Amount
1960	$ 15,000
1961	1,185,977
1962	58,414,271
1963	3,966,957
1964	7,964,365
1965	8,397,978
1966	10,906,048
1967	18,388,388
1968	7,816,329
Subtotal	$117,055,329
1969	6,307,570*
1970	6,050,000*
Total	$129,412,899

* 1969, estimated expenditures; 1970, budget request (Independent Office Hearings, 1970, pp. 872, 886.

Source: Department of Defense, Office of Civil Defense, A Digest of Selected Financial and Workload Data as of 30 June, Fiscal Year 1951-1968, compiled by Budget Division, Office of the Comptroller.

This increasing marginal cost is to be expected. It is consistent with good business and efficiency practice to spend the "first dollars" to yield maximum return. The NFSS program no longer has the volume economies of mass and extensive surveys, and it would normally be expected that the costs of updating, and extending the survey emphasis to less densely populated "shelter deficit" areas, would raise the costs higher than the $1 per space actually experienced.

Special note is made of the fact that the 190 million NFSS spaces anticipated to have been located as of June 31, 1969, are not co-located with the approximately 208 million people in the United States. The NFSS spaces are, however, co-located with approximately 100 million people under almost any kind of movement condition. On the other hand, to provide a fallout shelter space for the entire population at any given time would probably require more than 300 million spaces.[16/]

Detailed and careful operational and countermeasure research in civil defense continues to yield surprising results. There is less known about the resources of our country, and their capabilities for civil defense, than is comforting to contemplate. For example, in 1959 it was estimated that existing shelter capacity could be increased at an average cost of $25 per space. Two years later, based on preliminary and crude data from the pilot surveys, the 1961 estimates worked out to $60 per space, and with the expectation of "improvable" spaces limited to about 25 million.

With the hindsight vision of 1969, the following dialogue, August 2, 1961, between Mr. John F. Devaney, Director of Systems Analysis, OCDM, and Mr. Herbert Roback, Staff Administrator of the Military Operations Subcommittee, suggests the perils of civil defense planning with incomplete knowledge.[17/]

16/ Independent Office and Department of Housing and Urban Development Appropriations for 1970, hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, 91st Cong., 1st sess., Part I, pp. 796 and 798.

17/ Civil Defense--1961, hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 87th Cong., 1st sess., August 1, 2, 3, 4, 7, 8, and 9, 1961, p. 85.

Mr. DEVANEY. Well, to begin with, based on the few shelter surveys we have, and this is from the pilot studies made, it looks like it might be feasible to make improvements that would provide shelter for about 25 million people more than you can get without the improvements, and that is about the limit to what there is in existing buildings.

Mr. ROBACK. Will you state that again? Twenty-five million people above those who would find their own way?

Mr. DEVANEY. No. Let us say that, when we mark the existing shelter, we could find acceptable shelter now for about 40 to 50 million people. If we make the feasible improvements in those buildings, we could increase the amount of shelter to 75 million; in other words, provide shelter in existing buildings for 25 million more people. That is all there probably will be. You cannot feasibly improve all buildings to shelter all people, because it would probably cost much more than to build separate shelters out in the park, let us say. All buildings are not susceptible to improvement.

Mr. ROBACK. What are the dimensions of the cost of these 25 million spaces to be upgraded?

Mr. DEVANEY. It would be on the order of $1-1/2 billion, probably, for the total cost, public and private.

Mr. ROBACK. $1-1/2 billion to -----

Mr. DEVANEY. Shelter that 25 million.

This amount for improvement, per space, averages about $60.

On July 11, 1963, Mr. Steuart Pittman, Assistant Secretary of Defense (Civil Defense), in his presentations before the Armed Services Committee estimated, from the 14,000 existing Government buildings surveyed in the NFSS, that an additional 745,000 shelter spaces could be obtained by providing ventilation at a cost of about $12 per space average cost. At that time Secretary Pittman also proposed to modify existing buildings for the purpose of providing 308,000 additional shelter spaces at $23 per space average cost.[18/]

18/ Civil Defense--Fallout Shelter Program, hearings before Subcommittee No. 3, Committee on Armed Services, H.R. No. 3517, 88th Cong., 1st sess., June 3, 4, 5, 6, 10, 11, 12, 17, 21, 24, 25, 26, 27, July 10, 11, 17, 18, 19, 23, and 31, 1963, Part II (Volume 2), p. 5190.

Since these 1963 estimates were made, additional hard facts from the NFSS disclose that about one-third of the current shelter inventory, or 60 million spaces, is in the basements of large buildings. A considerable amount of additional space available in these basements cannot be counted in the NFSS inventory because of inadequate ventilation. If this basement space could be utilized, it would offer a high level of fallout protection, and provide far better protection against blast effects than aboveground space. Table 2, "Blast Protection in Conventional Buildings," shows the advantages of belowground space for both residences and NFSS buildings.

Table 2

Blast Protection in Conventional Buildings

	Median Lethal Overpressure*	
Location	Residences	NFSS Buildings
Aboveground	5 psi	7 psi
Belowground	10 psi	12 psi

* The median lethal overpressure is that blast overpressure at which 50 percent of the occupants may be expected to be fatally injured.

Means of utilizing this basement space became a priority target of civil defense research. As a result, there have been developed portable, human-powered ventilation kits. These devices enable an additional substantial proportion of basement spaces to be ventilated and utilized at a cost of about $2 per space, as against $12 per space for permanently installed ventilating equipment. The cost reduction per space from this feature is well in excess of 90 percent. With these kits, almost 50 million more fallout shelter spaces are estimated to be available.

Additional research has indicated that for new fallout shelter construction, incremental costs would be in the order of $6.75 for each 10 square foot shelter space.[19/] To be conservative, the Office of Civil Defense estimates the costs at $9 to $14 per shelter space depending on the geographical area, the building size, payment method, topography, and other factors.

19/ Independent Office and Department of Housing and Urban Development Appropriations for 1970, p. 896.

Since 1965, in actual construction, 73 Federal construction projects have incorporated fallout shelter construction techniques at an average of 0.8 percent of total project construction costs, and the plans for an additional 116 Federal buildings have incorporated the techniques at no identifiable marginal cost.[20/]

Few shelters with protection against high blast overpressure have been constructed intentionally, but the belowground areas of existing structures have more potential for protection against blast than previously realized. The estimate of 10 psi as the median lethal overpressure for belowground residential areas, rather than lower psi estimates, has many implications for civil defense movement and shelter plans. The implications may be as significant as the findings of the NFSS in identifying life-preserving resources within the normal economy.

The location, marking, stocking, and augmentation of National Fallout Shelter Survey spaces answer to part of the entire civil defense shelter problem. Blast vulnerability must also be considered. There are additional concerns of unprecedented complexity involved in matching people to the best protection available, and publicizing these allocations within a total preparedness context. An operational civil defense system must provide specific information as to what each citizen should do, and within a feasible context.

It has been noted that only about half the NFSS fallout shelter spaces located would be in reasonable proximity to the population.[21/] On the other hand, no area is totally without fallout protection, even though it may not qualify for PF 40 and other requirements for public shelter marking. Every citizen, and every locality, are expected to somehow be prepared to make full use of whatever shelter resources are available. Further, it is a basic responsibility of local governments, mayors, policemen, firemen, local civil defense directors, and other officials to plan and to assist their citizens. The planning and exercise requirements for such a preparedness posture require funds, professional personnel, and time.

Some comprehension of the years required, the costs, the inter-agency coordination, the federal-state-local cooperative relationship, and the public and private sector relationships involved in movement and shelter planning can be provided by a review of the Community Shelter Planning program

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20/ Ibid, p. 881.

21/ See p. 14

of civil defense. The Community Shelter Planning (CSP) program of the Office of Civil Defense is designed to assist localities throughout the United States to utilize the NFSS spaces, and other protective resources as necessary. However, protection against fallout is stressed, not protection against blast. CSP necessarily involves combinations of movement and shelters. The planning features of allocating population to existing shelters is fully Federally supported. The CSP program relies to a maximum on local urban planning professionals. The work is funded under contracts between the larger and more populous urban areas and the Army Corps of Engineers or Navy Facilities Engineering Commands, which administratively act on behalf of the Office of Civil Defense.

For the less heavily populated areas, community shelter plans (CSP's) are provided through contractual assistance between a state and the Office of Civil Defense. This arrangement provides for professional urban planning service to be made available from the state level. Under these CSP procedures, as of the end of FY 1969, about 265 counties with a population of about 55 million were being covered under direct contracts; and 840 counties with a population of about 17 million were being provided with CSP's prepared under the state-OCD direct contract support procedure.

CSP costs for the larger cities, such as New York City, Los Angeles, San Francisco Bay area, Milwaukee, Racine, and Minneapolis-St. Paul, are estimated at about $.07 per capita, but as of the close of 1969, none of these large city plans have been completed. The per person costs are somewhat higher for the less heavily populated areas, and average about $.13 per capita.[22/]

The basic techniques being implemented in Community Shelter Planning were developed in 1962 through exploratory studies conducted by OCD in Boston, San Diego, and Lincoln, Nebraska. This experience was utilized in 1963 as a part of the preparation of the first prototype fallout shelter use plan. This plan, for Montgomery County, Maryland, was accomplished

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22/ Ibid., p. 888. A CSP for an urban area of about 250,000 costs about $40,000, and takes about two years from start to completion.

under a Stanford Research Institute contract in the amount of $250,000, and included complete shelter assignments for the county, plus other features of a civil defense emergency plan.

The next phase in CSP development was the selection, in 1963, of 16 cities, two for each of the eight OCD Regions. The purposes were to field-test the lessons being learned in the Montgomery County plan, and to determine the feasibility of developing similar plans through the use of urban planning professionals, operating under the guidance of municipal and county government as well as Federal assistance. The "16-city" project was completed in early 1964.

CSP then moved into a third phase. The third phase was based on the selection by each OCD regional director of one community in each state within his region and, with the approval of state and appropriate local civil defense director, further testing of the community shelter planning concepts. Fifty-seven cities were eventually involved. Professional urban planner services from each locality were provided. From this 50 city project (also known as the 57 city project), as well as predecessors, the Office of Civil Defense obtained the know-how with which to draft manuals for field guidance, and to develop the management system necessary for the efficient control and surveillance over Federal funds expected to be made available for community shelter planning.[23/]

Following an approximate four-year period of development, prototype, and field-testing, a more formalized program of Community Shelter Planning was initiated with FY 1966 funds. The expenditure listing is given in Table 3, "Community Shelter Planning Expenditures by Fiscal Year."

23/ Civil Defense 1965, MP-30, Department of Defense, Office of Civil Defense, April 1965, pp. 18-19. See also, National Community Shelter Planning Program, Federal Civil Defense Guide, Part D, Chapter 3, Appendix 1, December 1965, pp. 1 and 4.

Table 3

Community Shelter Planning
Expenditures by Fiscal Year

1966	$ 2,178,391
1967	5,190,724
1968	3,556,868
Subtotal	$10,925,983
1969	2,511,131*
1970	4,000,000*
Total	$17,437,114

* 1969, estimated expenditures; 1970, budget request; Independent Office and Department of Housing and Urban Development Appropriations for 1970, hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, 91st Cong., 1st sess., Part I, pp. 872, 886.

Source: Department of Defense, Office of Civil Defense, A Digest of Selected Financial and Workload Data, as of 30 June, FY 1951-1968, compiled by Budget Division, Office of the Comptroller.

By the end of FY 1970 it is estimated that areas with a population of 109 million (1960 Census data) will be covered under CSP's for a total cost of about $18 million. This is an average cost of about $.16 per capita. From the current levels of CSP expenditure and accomplishment, it is obvious that completion of CSP objectives will require over a decade. However, this rate could be increased substantially in an emergency, or by the provision of more funds by the Congress. In reality, the dynamics of population shifts, new construction, urban renewal programs, active defense improvements or cutbacks, and transportation and other technology changes means that movement and shelter allocations such as those of CSP can never be considered complete, even if the enemy threat were to stabilize.

The magnitude of the CSP job remaining, as well as its complexity, is suggested further by reference to Table 4, "Cities of 25,000 or More Population with Marked NFSS Spaces Accommodating 5 Percent or Less of 1960 Population." Analysis of such selected planning statistics for the civil defense mission in the United States highlights the dangers of generalizations. NFSS space is not uniformly distributed by city size, north-to-south location, or other clear criteria. For example, of the 107 cities with marked NFSS spaces for 5 percent or less of their population, one might have expected more than 16 to be in the states of the Southeast. Colder winters and basement frequency are not always closely correlated with the more massive construction required for designation as a NFSS building. A study of this table also re-affirms the conclusion that utilization of the National Fallout Shelter Survey resources will necessitate a significant amount of movement and transportation, as well as expedient shelter construction.

No Civil Defense movement, or shelter, or combined planning program has ever been completed. Unpredictable circumstances, or factors over which Civil Defense authorities have no significant control or influence, have required curtailment or major changes in emphasis. On the other hand, the basic strategy of civil defense in a changing environment is fundamental and simple: to exploit time to move population to shelter, and to utilize whatever protection that space, or man-made shelter, or natural shelters may offer.

Table 4

Cities of 25,000 or More Population with Marked NFSS Spaces Accommodating 5 Percent or Less of 1960 Resident Population

City	Percent	City	Percent
Fairfield, Conn.	4	Pekin, Ill.	5
Manchester, Conn.	3	Wilmette, Ill.	0
Norwalk, Conn.	2	New Albany, Ind.	5
Lorrington, Conn.	2	E. Detroit, Mich.	3
Wallingford, Conn.	0	Garden City, Mich.	2
Bergenfield, N.J.	1	Inkster, Mich.	1
Middleton, N.J.	4	Livonia, Mich.	1
Westfield, N.J.	5	Madison Heights, Mich.	1
Eggertsville, N.Y.	5	Oak Park, Mich.	4
Dundalk, Md.	5	Roseville, Mich.	1
Upper Arlington, Ohio	1	St. Clair Shores, Mich.	2
Falls, Pa.	3	Southgate, Mich.	2
McKeesport, Pa.	4	Bossier City, La.	4
Middletown, Pa.	0	Hobbs, N.M.	1
Penn Hills, Pa.	0	Garland, Texas	2
Ridley, Pa.	4	Grand Prairie, Texas	4
Chesapeake City, Va.	4	Irving, Texas	5
Prichard, Ala.	0	Longview, Texas	3
Hialeah, Fla.	0	Midland, Texas	0
N. Miami, Fla.	4	Orange, Texas	1
Marietta, Ga.	1	Pasadena, Texas	5
High Point, N.C.	4	Texarkana, Texas	2
Kannapolis, N.C.	0	Florissant, Mo.	0
Arlington Hts., Ill.	0	Kirkwood, Mo.	1
Berwin, Ill.	0	University City, Mo.	1
Calumet City, Ill.	5	Calif.--49 cities	
Elmhurst, Ill.	3	Hilo	3
Freeport, Ill.	0	Kailua	0
Joliet, Ill.	0		
Maywood, Ill.	3		
Park Forest, Ill.	2		

U.S. Population-Total 1960	181,835,000
1960 Population of 25,000+ Cities	81,284,000
Total Marked NFSS Spaces	105,000,000
Marked Spaces of 25,000+ Cities	83,162,000

Source: Department of Defense, Office of Civil Defense, Selected Statistics on the Fallout Shelter Program, OCD Statistical Report 7720.75 (as of March 25, 1969), Table 3, pp. 22-46.

Chapter 2

Inward Movement and/or Shelter Related to the Threat and Attack Environment

Civil Defense research and operating personnel in 1970 are confronted with a mix of warning time, weapon types, and active-passive interactions totally different from anticipations of a decade ago. Among the factors that lead to this conclusion are the following:

1) A growing awareness of a significant probability that general nuclear war need not be cataclysmic, but might be preceded by a relatively prolonged period of negotiations and tension. This period might last several days, weeks, or even months. The probability cannot be measured. Many treaties,[24/] as well as the proper nouns of Korea, Berlin, Cuba, Pueblo, and Vietnam are suggestive of caution, restraint, deliberation, diplomacy, and controlled response, rather than all-out military reaction.

2) The availability of a far greater amount of high-quality fallout shelter in the United States, particularly outside the cities of under 25,000 population, than was ever realized or projected prior to the National Fallout Shelter Survey. During the 1961 Berlin crisis, and as a part of his first Civil Defense program submission to the Committee on Government Operations, August 1, 1961, Secretary McNamara stated that:

24/ Since 1958, the U.S. and the U.S.S.R. have adopted five significant mutual restraints, each of which culminated in a formal treaty. They are: the nuclear test moratorium of 1958-1961; the Antarctic Treaty of 1959; the Nuclear Test Ban Treaty of 1963; the treaty for Peaceful Use of Outer Space, in 1967; and the Nuclear Non-Proliferation Treaty of 1968.

> "Our best estimate by extrapolation from pilot surveys made in the past is that this program will identify some 50 million usable shelter spaces, and will provide a minimum of shelter for approximately one-fourth of our population.... The survey itself, which is to be completed by December 1962, at a cost of $93 million, will concentrate first on metropolitan areas, which are also likely to have the largest number of available shelter spaces."25/

It has now developed that there are almost 150 million NFSS spaces within cities and an additional 39 million spaces outside cities of 25,000 or more population.

3) Full utilization of NFSS spaces increases concentration and vulnerability of urban populations to blast and fire effects. (This factor is developed more fully in later portions of this chapter.)

4) There is far more, and better, and more beneficial fallout shelter space in private homes than before realized. It is now estimated that about 29 million U.S. homes have basements. Some 15 million homes have been surveyed. Of these, it is estimated that over 8 millions have shelter rated at 20 PF or better. This shelter resource space, if used only by the residents, will provide protection factors of 40 or more for almost 2 million persons; and protection factors of 20-39 for another 28 millions. This resource has great civil defense potential.

5) Increased knowledge of procedures, and techniques for improvement of fallout, fire, and blast protection under tension or "crash" preparedness conditions can reduce casualties and fatalities in significant numbers.

25/ Civil Defense--1961, p. 7.

6) Indefinite deferment, or rejection, of a blast shelter program, and of extensive active defenses designed to protect population against massive attack. At the time of initiation of the National Fallout Shelter Survey, active defense measures were regarded as complementary with the more indirect civil defense responses. Referring again to the testimony of Secretary McNamara in August of 1961, the following extract is pertinent:[26/]

> "I want to point out also that while a substantial blast shelter program is somewhat competitive with active defense systems such as the Nike-Zeus, now in development, fallout shelter is complementary rather than competitive to such a system. If we are able to develop a satisfactory missile defense system, the need for blast shelter is proportionately reduced."

President Richard Nixon's statement on ABM deployment March 14, 1969, indicates a substantial change from an active defense deployment objective complementary to that of a fallout shelter system. President Nixon's statement candidly described the objectives of the SAFEGUARD system, as follows:

26/ Ibid., p. 6.

"This measured deployment is designed to fulfill three objectives:

1. Protection of our land-based retaliatory forces against a direct attack by the Soviet Union;

2. Defense of the American people against the kind of nuclear attack which Communist China is likely to be able to mount within the decade.

3. Protection against the possibility of accidental attacks from any source.

"In the review leading up to this decision, we considered three possible options in addition to this program: A deployment which would attempt to defend U.S. cities against an attack by the Soviet Union; a continuation of the Sentinel program approved by the previous Administration; and indefinite postponement of deployment while continuing Research and Development.

"I rejected these options for the following reasons:

"Although every instinct motivates me to provide the American people with complete protection against a major nuclear attack, it is not now within our power to do so.

"The heaviest defense system we considered, one designed to protect our major cities, still could not prevent a catastrophic level of U.S. fatalities from a deliberate all-out Soviet attack. And it might look to an opponent like the prelude to an offensive strategy threatening the Soviet deterrent.

"The Sentinel system approved by the previous administration provided more capabilities for the defense of cities than the program I am recommending, but it did not provide protection against some threats to our retaliatory forces which have developed subsequently. Also, the Sentinel system had the disadvantage that it could be misinterpreted as the first step toward the construction of a heavy system."

From a narrow view of warheads alone, the weapon threat has remained relatively constant during the decade of the sixties. The megatonnage, and the number of weapons generally considered, are comparable with 1961 forecasts when the Department of Defense was assigned responsibilities for civil defense. Contrasted with the military technology turmoil of the fifties, there have been no similar "surprises" in offensive delivery systems and tactical warning expectations. To the contrary, the surprises have been in the area of unexpectedly extensive protection resources, or effective countermeasure capabilities.

The attack environment assumed by Mr. McNamara in 1961 would result in 50 million fatalities with some 20 million additional injuries; and with 75 percent of the deaths caused by blast and thermal effects directly or combined with fallout effects. The estimates of 1961 anticipated some 50 million fallout shelter spaces to be located, and these would be primarily in the central city areas. In fact, as the NFSS has revealed, almost 150 million NFSS spaces are located in cities of 25,000 population and over. Low-cost ventilation kits developed in the last several years can make useable better protection in basements, with higher blast resistances, for about 50 million spaces; but the spaces are not necessarily additive.

There is a substantial degree of difference between a 1961 civil defense strategy anticipating 50 million fallout shelter spaces, and the situation in 1970 and the foreseeable future. In 1961 a probable maximum of 50 million people were estimated to move to shelter, probably into larger buildings in central cities, so as to utilize the scarce fallout shelter. There are now quite plausible possibilities, under the CSP program, for more than twice that number to move into the central cities to take advantage of the more abundant fallout shelter located therein. Table 5, "Cities of 25,000 or More Population with Marked NFSS Spaces Accommodating 150 Percent or More of 1960 Resident Population," lists 61 of our larger cities. As listed therein, 105 million spaces have already been marked for these cities of 25,000 or over.

The statistics are for <u>cities</u>, not Standard Metropolitan Statistical areas, a definition distinction important to full realization of the degree of population concentrations feasible when one uses NFSS space intensively.

Table 5

Cities of 25,000 or More Population with Marked NFSS Spaces Accommodating 150 Percent or More of 1960 Resident Population

City	Percent	City	Percent
Hartford, Conn.	296	Nashville, Tenn.	170
New Haven, Conn.	326	Oak Ridge, Tenn.	246
Boston, Mass.	189	Urbana, Ill.	203
Atlantic City, N.J.	552	East Chicago, Ind.	236
Elizabeth, N.J.	167	Terre Haute, Ind.	173
Hoboken, N.J.	154	Southfield, Mich.	154
Jersey City, N.J.	157	Duluth, Minn.	166
Newark, N.J.	250	Minneapolis, Minn.	219
New Brunswick, N.J.	192	Rochester, Minn.	264
Trenton, N.J.	172	St. Cloud, Minn.	261
Albany, N.Y.	161	St. Paul, Minn.	207
Buffalo, N.Y.	170	Madison, Wis.	157
New York City, N.Y.	213	Hot Springs, Ark.	211
Rochester, N.Y.	172	Little Rock, Ark.	206
Utica, N.Y.	156	Norman, Okla.	221
Wilmington, Del.	240	Dallas, Texas	192
Washington, D.C.	484	Boulder, Colo.	200
Lexington, Ky.	221	Fort Collins, Colo.	221
Bethesda, Md.	240	Des Moines, Iowa	131
Cheltenham, Pa.	161	Kansas City, Kan.	162
Harrisburg, Pa.	394	Kansas City, Mo.	171
Lower Merion, Pa.	198	Lincoln, Neb.	158
Philadelphia, Pa.	212	Minot, N.D.	160
Pittsburgh, Pa.	170	Beverly Hills, Calif.	266
Arlington Count, Va.	245	Oakland, Calif.	157
Portsmouth, Va.	153	Pasadena, Calif.	157
Miami Beach, Fla.	241	Sacramento, Calif.	184
Tallahassee, Fla.	314	San Francisco, Calif.	180
Atlanta, Ga.	295	W. Hollywood, Calif.	229
Durham, N.C.	205	Salem, Ore.	203
Raleigh, N.C.	190		

U.S. Total 1960 Population	181,835,000
1960 Population of 25,000+ Cities	81,284,000
Total Marked NFSS Spaces	105,000,000
Marked NFSS Spaces 25,000+ Cities	83,162,000

Source: Selected Statistics on the Fallout Shelter Program, OCD Statistical Report 7720.75 (as of March 25, 1969), Department of Defense, Office of Civil Defense, Table 3, pp. 22-46.

Typical large cities, such as the eight largest in Ohio (Cleveland, Columbus, Cincinnati, Toledo, Akron, Dayton, Youngstown, and Canton), have an average population density per square mile of about 7,200 persons. If measured in SMSA definitions, which includes city and all other area to county boundaries, the density for these eight Ohio SMSA's averages slightly under 800 persons per square mile.[27/]

Movement to NFSS spaces, as suggested under possible CSP interpretations for full utilization of NFSS spaces, would present an enemy with inviting and vulnerable targets for the blast and fire effects of his weapons.

As Table 5 indicates, CSP concentrations to exploit NFSS spaces might cause greater casualties in some instances than if the population were not intentionally aggregated to make maximum use of existing fallout shelter.

Because of technical computational lags, data gaps, and changing data, the strategic implications of CSP efforts oriented to NFSS and the threat environment can only be reflected generally in civil defense casualty calculations. One important technical reason for this computational lag is the fact that many CSP's are in an advanced planning stage, but have not yet been completed. It is difficult, expensive, inaccurate, and premature at best to predict the population distribution and vulnerability criteria contemplated to be accomplished as a result of the CSP's.

Chart 2, "Population and Space Distributions," prepared by the Stanford Research Institute as a part of their Emergency Operations Systems Development Project, 1968,[28/] illustrates the trade-off between existing fallout shelter protection and its target attractiveness to an enemy, especially if the space is occupied.

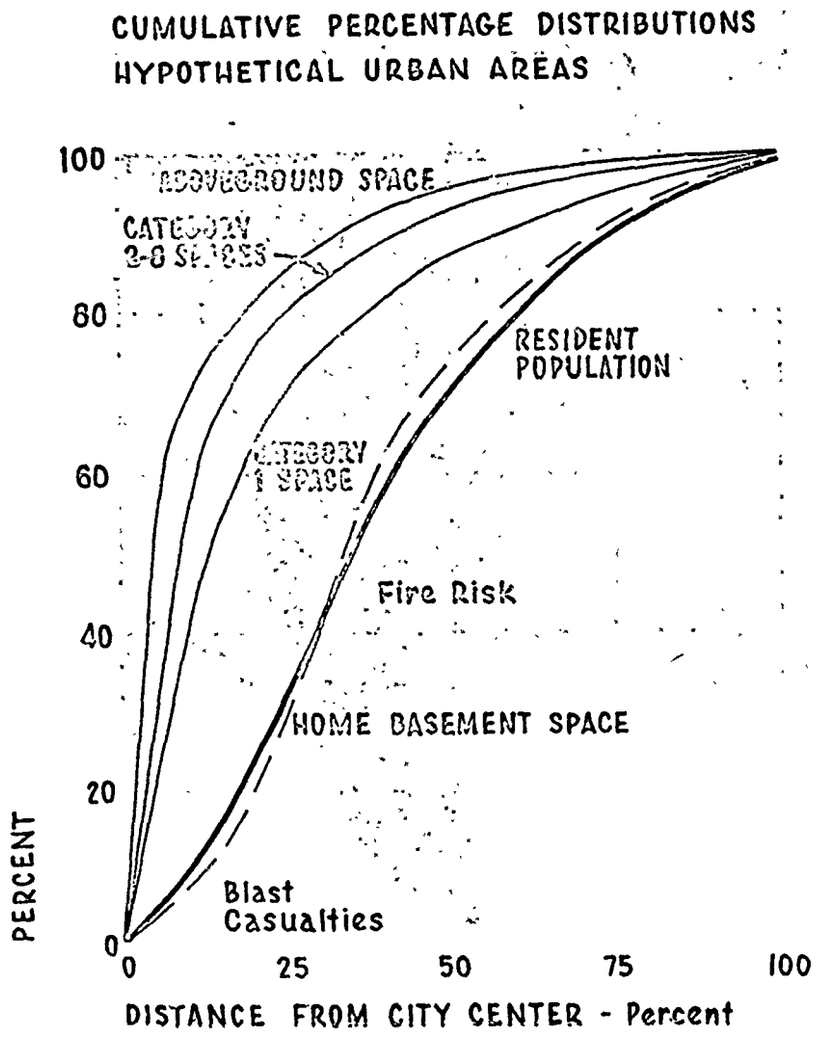
Stanford Research Institute describes the chart and the implications thereof clearly, and their explanation is reproduced on the page following Chart 2.

27/ System Development Corporation, Selected U.S. Land Area and Population Data, Technical Memorandum, TM-L-2595/008/00, March 1, 1967.

28/ Stanford Research Institute, Emergency Operations Systems Development Project, Phase II-Integration and Community Shelter Planning Interim Solutions to Shelter Deficits, January 1968, p. 14.

Chart 2.

POPULATION AND SPACE DISTRIBUTIONS



Source: Stanford Research Institute, Emergency Operations Systems Development Project Phase II Integration and Community Shelter Planning Interim Solutions to Shelter Deficits, January 1968, p. 14.

POPULATION AND SPACE DISTRIBUTIONS

This chart shows cumulative percentage distributions of resident population, and of the important space resources, by percent distance from city center superimposed on a background reflecting the nuclear environment that would result from a surface burst on the city center. Although the data are presented in hypothetical terms, the implications are applicable to many U.S. metropolitan areas. In preparing the population and space distributions, computer analyses were made of all SMSAs (Standard Metropolitan Statistical Areas).

The horizontal axis reflects percentage distance from the CBD (Central Business District) of the city center to the edge of the urbanized area surrounding the city, as defined by the outer boundary of an SMSA. Thus, the area defined by a circle with a radius equal to about 25% of the distance from city center to outer boundary of an SMSA--3 to 4 miles for many SMSAs of moderate to large size--includes about 30% of the population. This same area includes about 80% of the NFSS spaces, 85% of the above-ground (RSA) spaces, and 70% of the PF category 1 spaces.

In general, RSA space tends to be more heavily concentrated in downtown areas than NFSS space; PF category 1 space is somewhat less concentrated. But reliance on these space resources would result in a significant inward shift of the population. Home basements tend to be distributed like population and, if more than one family were sheltered per basement, could be used to provide varying shelter postures.

The blast and fire effects shown are roughly equivalent to those resulting from a 10 MT surface burst on the city center of an SMSA of about one million population (or a 3 MT surface burst on the central city of an SMSA of about 300,000). The light area indicates blast fatalities--ranging from about 100% at point of burst to zero at about 50% of the distance from city center to outer boundary. The shading designates the fire risk area, which declines in significance as distance from point of burst increases.

The effect of an inward movement based on NFSS, RSA, and PF category 1 space is to increase fatalities to nearly 100%, if sufficient space is available to shelter the entire population. Although priority is given to NFSS space in current CSP guidance, maximum movement time is limited to one hour (for SMSAs of 100,000 or more). The resulting shelter posture, therefore, reflects only a partial inward shift of the population. More extensive use of home basements than is currently recommended in OCD guidance will permit dispersal of population from areas potentially subject to blast and severe fire effects. The availability and effectiveness of such dispersal is discussed in ensuing charts.

Source: Stanford Research Institute, Emergency Operations Systems Development Project Phase II Integration and Community Shelter Planning Interim Solutions to Shelter Deficits, January 1968, p. 15.

Implications of Chart 2 are presented further in even more clear-cut terminology by an additional SRI illustration, reproduced as Chart 3, "Effect of Dispersal." This chart is based on two gamed attacks provided by the Policy and Programs staff of OCD. The first attack, "Initiative Attack," is a heavy mixed attack reflecting enemy first strike or initiative capability; 204 of 212 SMSA's in the United States receive blast and other direct effects. The second attack, "Retaliatory Attack," assumes a first strike by the United States, with only 100 of our SMSA's receiving blast and other direct effects.

The protection from blast effects afforded by space, or possible moves away from city centers, can be estimated in terms of differences in fatalities, as shown in Chart 3, "Effect of Dispersal." Dispersing a metropolitan population eight miles away from the city center reduces blast fatalities from 27 percent to 5 percent. Survivors are increased from 37 percent to 65 percent. A further shift to 14 miles from city centers reduces blast fatalities to 3 percent and increases survivors to 80 percent.

Similar reductions in fatalities are noted from a careful examination of the fatalities and survivor percentages associated with the "Retaliatory Attack."

It is noted that the "Retaliatory Attack" calculations, which assume the United States attacking first, is not in accord with announced policy, and it is presented only for the purpose of demonstrating the value of dispersal under the different hypothetical situations.

An illustration prepared by the Office of Civil Defense is Chart 4, "Exposure to Blast and Fallout--Hypothetical Heavy Attack on Military, Industrial, and Population Targets." This chart shows blast levels and radiation levels by differing degrees of severity. It highlights the vulnerability of metropolitan areas to blast effects of modern weapons. Analysis of the blast levels portions of this chart shows that 59 percent of the U.S. total population are in areas receiving 1 PSI and higher of blast damage, and that this 59 percent of the population is concentrated in about 10 percent of the area of the United States.

Chart 3.

EFFECT OF DISPERSAL

INITIATIVE ATTACK (ENEMY ATTACKS FIRST)

OUTWARD SHIFT OF POPULATION	PERCENT FATALITIES		PERCENT SURVIVORS	
	Blast	Fallout	Fire Risk	Other
0 miles	27	17	19	37
8	5	20	10	65
14	3	15	2	80

RETALIATORY ATTACK (U.S. ATTACKS FIRST)

0	11	2	20	67
8	5	2	12	81
14	2	2	5	91

NOTE: METROPOLITAN POPULATION
PROTECTION LEVEL: REINFORCED HOME BASEMENT, PF 36

Source: Stanford Research Institute, Emergency Operations Systems Development Project. Phase II Integration and Community Shelter Planning Interim Solutions to Shelter Deficits, January 1968, p. 16.

EFFECT OF DISPERSAL

The effect of dispersing metropolitan populations on percent fatalities from blast and fallout and on percent of population at risk from fire is shown in this chart for two gamed attacks provided by "Policy and Programs, OCD" The first is a heavy mixed attack reflecting enemy first strike or initiative capability; 204 of the 212 SMSAs receive direct effects. The second attack reflects enemy retaliatory capability, assuming a first strike by the U.S.; 100, or less than 50% of the SMSAs, receive direct effects.

The zero-mile dispersal represents population in a resident posture. For the 8-mile dispersal, population was shifted to an area 8 to 10 miles from the city center or other points of urban concentration; for the 14-mile dispersal the shift was to a ring 14 to 16 miles outward. For illustrative purposes a protection level equivalent to that characterizing a home basement structurally modified to provide a PF of 36 is used. The impact of varying the protection levels available to the population in the three postures is discussed in later charts.

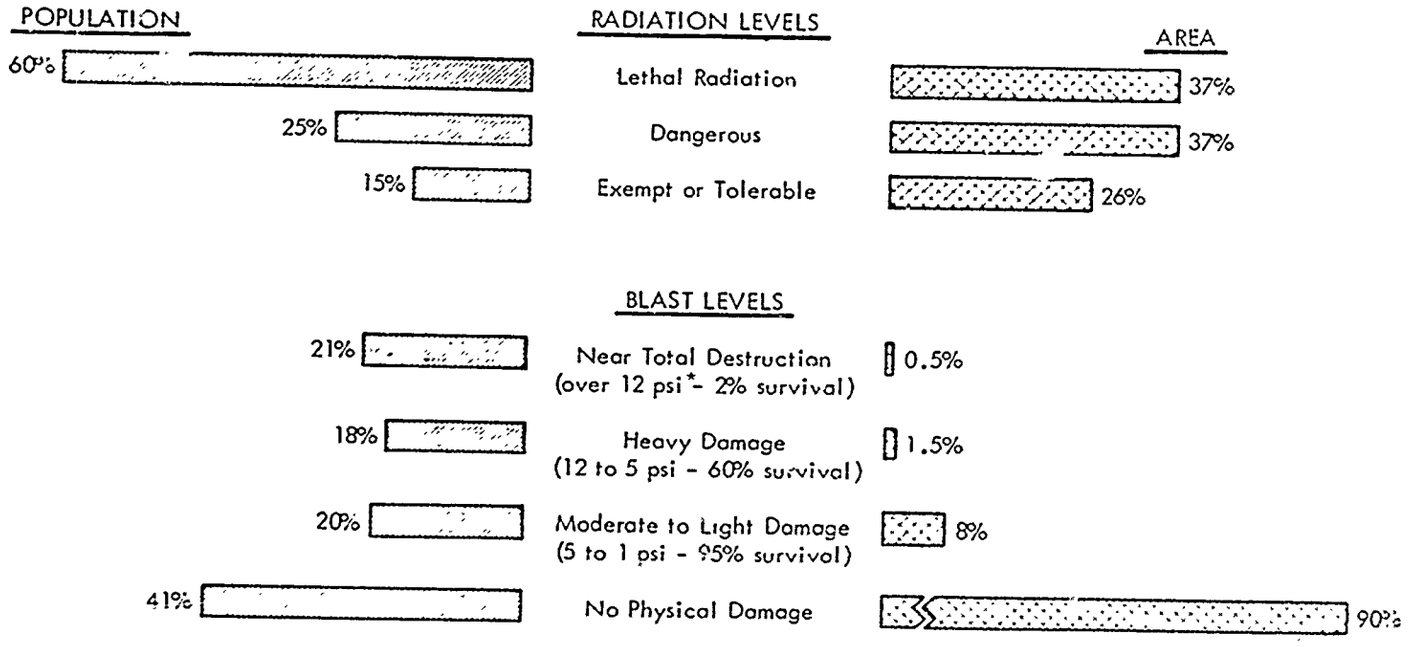
The effect of dispersal on casualty levels is striking. Fatalities from blast under the initiative attack decrease from 27% to 3% of the population of SMSAs with an 8 mile shift, and to 3% with a 14 mile shift. Dispersal had little effect on fallout fatalities but resulted in significant reductions in percent of population at risk from fire. As a consequence, the percent of population not exposed to nuclear effects (labelled "other" in the chart) increased substantially. The effects were similar under the retaliatory attack in spite of the smaller weight of this attack--as evidenced by generally lower blast and fallout fatality rates, regardless of posture.

More detailed analyses illustrated in ensuing charts are limited to the initiative attack. Since the retaliatory attack assumes a first strike by the U.S., and since it is announced policy not to employ this strategy, it does not appear valid to use such an attack as a basis for policy determination. The initiative attack, on the other hand, is well within enemy capability and reflects optimal selection of strategic and population targets.

Source: Stanford Research Institute, Emergency Operations Systems Development Project: Phase II Integration and Community Shelter Planning Interim Solutions to Shelter Deficits, January 1968, p. 17.

Chart 4

EXPOSURE TO BLAST AND FALLOUT HYPOTHETICAL HEAVY ATTACK ON MILITARY.INDUSTRIAL AND POPULATION TARGETS



*Pounds per square inch of blast pressure

Source: U.S. Department of Defense, Office of Civil Defense, Fallout Shelter Program, June 1964, p. 17.

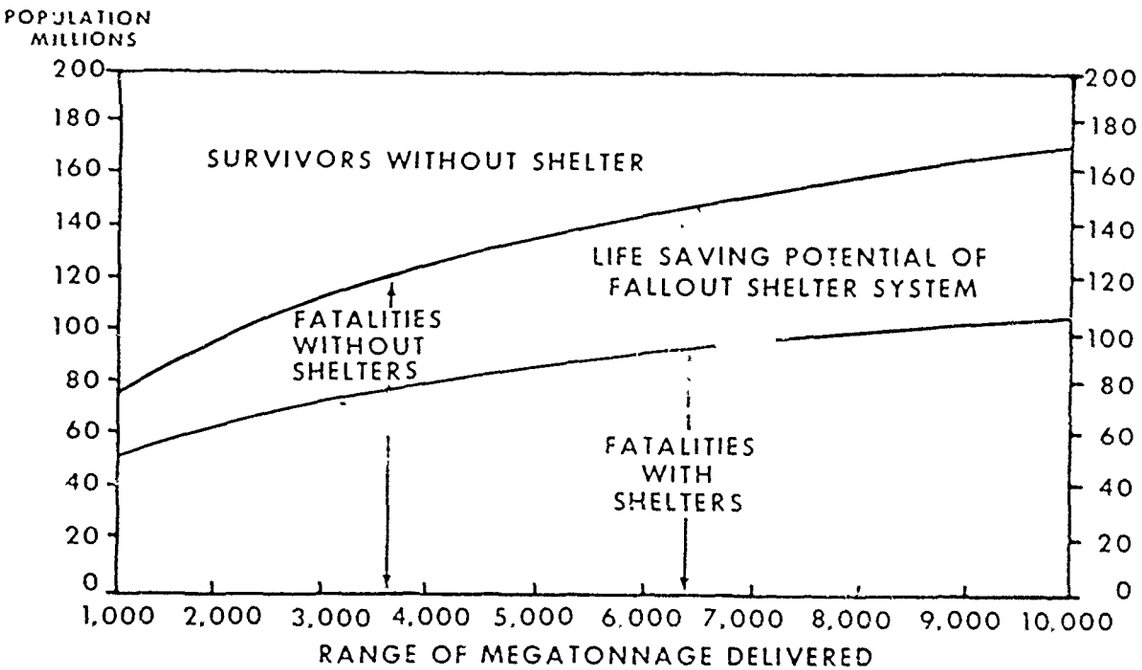
A great deal remains to be accomplished to understand the interactions between movement, shelter, and the options of defense and offense, and the NFSS and CSP data invite further analyses in these terms. Nevertheless, it appears clear that the apprehension suggested by the Stanford Research Institute studies, as well as this report, indicates that full utilization of NFSS spaces would congregate populations so as to expose them to blast effects, and a higher risk of fatality, than they would experience by staying in their homes.

The circumstance of many NFSS spaces being located in downtown areas presents significant hazards in assembling the population to take advantage of the NFSS marked shelter, and its supplies, and thus presenting an even more attractive target to enemy planning. Such concentrations of population, if carried to an excess, may well end up causing more fatalities than would have occurred in the absence of a CSP program. There is significant danger that the lives hoped to be preserved against fallout effects may thus be forfeited, by incomplete planning, as fatalities to direct blast and fire causes.

Chart 5, "Life Saving Potential of Fallout Shelter System in Attacks Against Military-Urban-Industrial Targets," is widely used in civil defense planning, and presents the essence of the publicized case for a national fallout shelter system. The higher curve shows "Fatalities Without Shelters." It provides a basis for estimating the lifesaving potential of a fallout shelter system. However, excessive crowding of suburban populations into downtown NFSS spaces through CSP would cause the lower curve, "Fatalities With Shelter," to be raised accordingly, and thus decrease the lifesaving potential. The additional lives lost might therefore be described as fatalities resulting from excessive congregations of population in downtown NFSS spaces.

Chart 5

LIFE SAVING POTENTIAL OF FALLOUT SHELTER SYSTEM IN ATTACKS AGAINST MILITARY-URBAN-INDUSTRIAL TARGETS



SOURCE COMPOSITE OF DAMAGE ASSESSMENT STUDIES BY DEPARTMENT OF DEFENSE

IN EVENT OF ATTACKS AGAINST MILITARY TARGETS ALONE TOTAL FATALITIES WOULD BE REDUCED AND LIFE SAVING POTENTIAL OF SHELTERS WOULD BE INCREASED

Source: U.S. Department of Defense, Office of Civil Defense, Background of Civil Defense and Current Damage Limiting Studies, TR 35, June 1966, p. 13.

In typical attacks such as those portrayed in Chart 5, "Life Saving Potential of Fallout Shelter System in Attacks Against Military-Urban-Industrial Targets," about two-thirds of the fatalities occur in the blast areas, and the remaining fatalities are essentially caused by fallout alone. This chart was developed in 1962 and 1963 from many damage assessment studies made by the Department of Defense,[29/] and is a composite from about 20 attack patterns developed over the 1961-1963 time period. Assuming the enemy does not change significantly his attack objectives and capabilities, and assuming further that significant relocations of population do not occur, such as are contemplated by the CSP program, the chart is a valuable planning tool.

The consistency of type and extensiveness of the enemy threat and capabilities is suggested by later analyses such as those presented in Chart 6, "Lifesaving Potential of Improved Strategic Defense." This chart also shows about two-thirds of fatalities caused by blast and one-third caused by fallout. Compared with the "No Shelter" bar, population at risk are shown to be "savable" by the "Full Fallout Shelter" program. This savings of 48.5 million lives is during a projected population period of 1968-70, as shown in Bar I. This relationship is presented in Bar I entitled "Full Fallout Shelter."

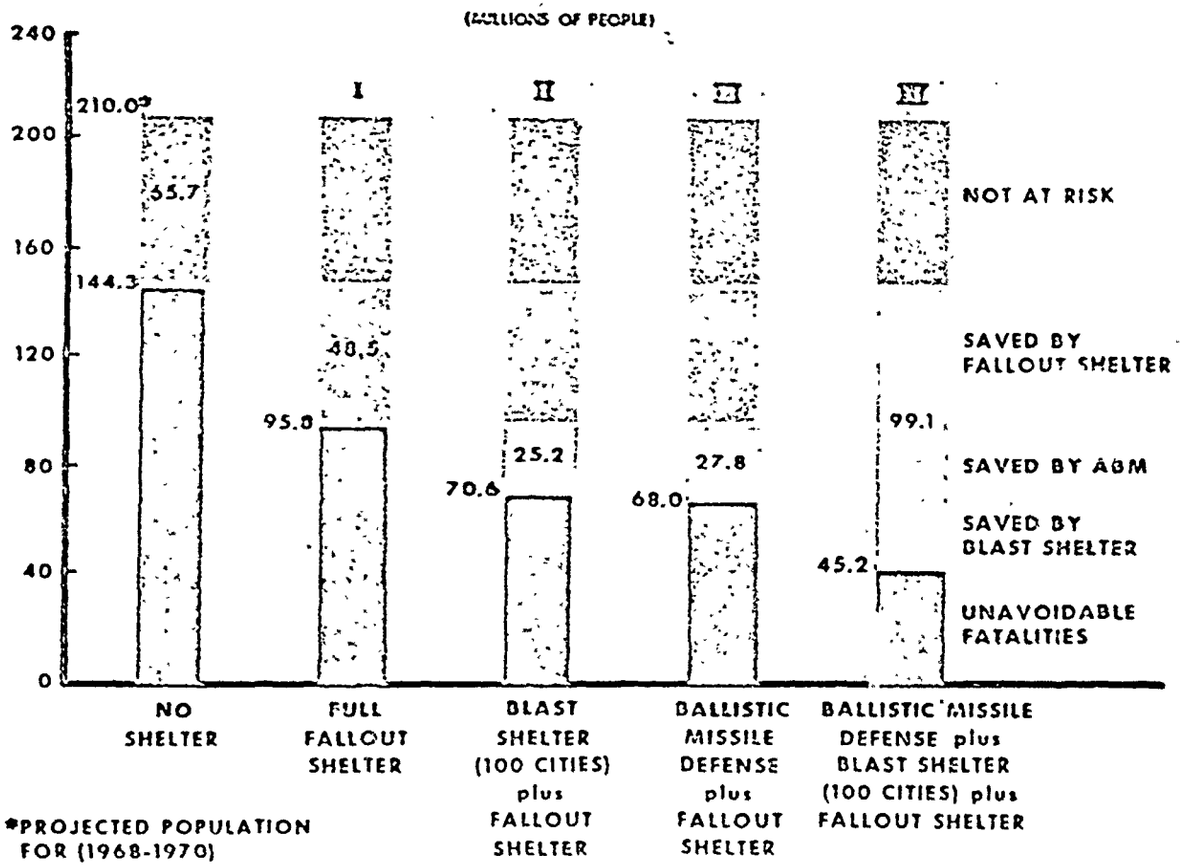
Under Bar II, which contemplates a blast shelter program for 100 cities plus the full fallout shelter program, some 25.2 million are estimated to be saved.

Bar III, "Ballistic Missile Defense plus Fallout Shelter," shows an estimated savings of 27.8 million lives.

29/ Civil Defense--Fallout Shelter Program (Armed Services Committee), p.5147.

Chart 6

LIFESAVING POTENTIAL OF IMPROVED STRATEGIC DEFENSE



Source: U.S. Department of Defense, Office of Civil Defense, Background of Civil Defense and Current Damage Limiting Studies, TR 35, June 1966, p. 12.

All three programs, the Full Fallout Shelter program, Blast Shelter for 100 Cities, and the Ballistic Missile Defense program, indicate a lifesaving potential of 99.1 million, as shown in Bar IV.

It is noted that the programs are not entirely distinguishable and separate. There are unavoidable computational problems associated with the uncertainties of incomplete CSP projects, and possible double counting of individuals who may be saved by either ballistic missile defenses or a blast shelter program, as well as the probability that one or more cities that did not have a blast shelter program and were not defended directly by ballistic missile defenses may nevertheless receive significant benefit from such defenses.

The alternative programs represented in Bars I to IV recognize the necessity for movement necessary to utilize the NFSS spaces. At the time they were conceived, active ABM defenses and blast shelters were being considered as protective measures against blast effects. Active ABM defenses and blast shelters to protect population were removed from p ogram consideration, by Presidential decision, as noted, in early 1969. A change in active defense planning can be expected to change civil defense planning. To do otherwise suggests passive acquiescence to a condition under which almost 100 million are concentrated at great risk to blast effects. The resulting concentration, and risk to blast effects, is greater with than without CSP.

An authoritative and unclassified set of data that projects into the future and includes estimates of U.S. and Soviet capabilities is that presented by former Secretary of Defense, Robert McNamara, in his program statement for the Fiscal Years 1969 to 1973.[30/] As a part of his presentation, Secretary McNamara included a table, reproduced below, "Numbers of Fatalities in an All-Out Strategic Exchange, Mid-1970's."

30/ Department of Defense Appropriations for Fiscal Year 1969, hearings before the Committee on Appropriations, H.R. 18707, 90th Cong., 2d sess., Part 5, Department of Defense, pp. 2685-2809.

NUMBERS OF FATALITIES IN AN ALL-OUT STRATEGIC EXCHANGE, MID-1970's[1]

(In millions)

U.S. program	Soviet response	Soviets strike 1st against military and city targets, United States retaliates against cities		United States strikes 1st at military targets, Soviets retaliate against U.S. cities United States retaliates against Soviet cities	
		U.S. fatalities	Soviet fatalities	U.S. fatalities	Soviet fatalities
No ABM	None	120	120	120	80
Sentinel	None	100	120	90	80
	Pen-Aids	120	120	110	80
Posture A	None	40	120	10	80
	MIRV, Pen-Aids	110	120	60	80
	Plus mobile ICBM's	110	120	90	80
Posture B	None	20	120	10	80
	MIRV, Pen-Aids	70	120	40	80
	Plus 550 mobile ICBM's	100	120	90	80

[1] At fatality levels approximating 100,000,000 or more, differences of 10 to 20,000,000 in the calculated results are less than the margin of error in the estimates.

"'Posture A' is a light defense against a Soviet missile attack on our cities. It consists of an area defense of the entire continental United States, providing redundant (overlapping) coverage of key target areas, and, in addition, a relatively low-density Sprint defense of 25 cities to provide some protection against those warheads which get through the area defense. 'Posture B' is a heavier defense with the same area coverage, but with much greater sophistication in its electronics and a higher density Sprint defense for 52 cities."

The calculations presented by Mr. McNamara suggest that blast continues to be the major hazard from all-out attacks within the Soviet capability. One year later, in January of 1969, Secretary of Defense Clark M. Clifford in "The 1970 Defense Budget and Defense Program for Fiscal Years 1970-1974" concurred with Secretary McNamara's general judgment that "the Soviet Union has the technical and economic resources needed to offset any strategically significant 'Damage Limiting' advantages we might gain by the deployment of an extensive ABM defense."[31/] Mr. Clifford's recommendation was for going ahead with Sentinel deployment as protection against a Chinese first strike in the 1975-1980 period. Secretary Clifford's Sentinel deployment priorities for population protection were not concurred in by President Nixon.

31/ "The 1970 Defense Budget and Defense Program for Fiscal Years 1970-1974," a statement by Secretary of Defense Clark M. Clifford, prepared January 15, 1969, p. 55.

Without a military defense program for population, or an impending blast shelter program, other alternatives must be postulated and analyzed. A desirable alternative must offer attractive probabilities for reduction of casualties from blast and fire effects. Protection against fallout must continue to be provided. If feasible, an alternative should also reduce the combined target attractiveness of our urban population and associated commercial and industrial capital. Current concepts present a "bonus" to the enemy, in the form of additional casualties, that he might, or might not, desire. Decreased vulnerability through removal of such "bonuses" contributes directly to the uncertainty of possible success of enemy plans; the greater the uncertainty, the less attractive an attack plan is to an enemy in the first place.

A desirable alternative would facilitate survival and recovery, in the event that attack occurs, and in no event make postattack operations more difficult. As will be described more fully in the following chapter, postattack analyses show that production will be limited more by labor shortages than by industrial capacity shortages. An alternative should also build upon the experience, competence, and knowledge acquired in preparation of CSP's. The alternative must be simple. It must be credible.

An alternative that meets the above criteria is believed attainable. It would substitute distance for the protection otherwise provided by either a blast shelter program or an active military defense program.

Chapter 3

Dispersion and Shelter as Feasible Responses

A review of research contractor reports has identified five different organizations, outside government, that have made extensive analyses of the problem of reducing vulnerability of urban populations to blast effects by movement. The feasibility of dispersion to existing shelter or shelter attainable within the time span believed available prior to an anticipated attack is the main theme of these reports. The more pertinent reports and their organizations (Hudson, Dikewood, SRI, IDA, and RTI) are as follows:

1) Hudson Institute, Strategic and Tactical Aspects of Civil Defense with Special Emphasis on Crisis Situations, January 7, 1963.

2) The Dikewood Corporation, Specific Strategic Movement Studies, May 1963, DC-FR-1030, Contract OCD-OS-62-2481. CONFIDENTIAL

3) Stanford Research Institute, Alternative Hosting and Protective Measures, December 1968, OCD Work Unit 2312C. CONFIDENTIAL

4) Institute for Defense Analyses, Allocating Contested Space in a Regional Movement-to-Shelter System: A Case Study of the Central Gulf Coast Region, January 1967.

5) The Dikewood Corporation, Vulnerability Reduction Using Movement and Shelter, DC-FR-1039, June 1965.

6) The Dikewood Corporation, A Model for Development of Preferred Mixtures of Evacuation and Shelter, DC-TN-1039-2, July 6, 1964.

7) Institute for Defense Analyses, "An Analysis of a Movement to Shelter System," Judith Timmermans, from Proceedings of the Civil Defense Systems Research Conference, October 1968.

8) Research Triangle Institute, Crash Civil Defense Program Study, April 1963.

9) Research Triangle Institute, Crash Civil Defense Program Planning, December 1964.

A review of these studies provides adequate basis for two feasibility conclusions: (a) with appropriate advance planning, extensive urban population dispersal can be accomplished within several days, and (b) adequate shelter can be improvised at dispersal destinations so as to offer significant protection against fallout. Dikewood Institute, for example, describes details of a two-day evacuation for the central cities of New York and Philadelphia, as well as Washington, Baltimore, Pittsburgh, Albany, Boston, and other Northeastern cities. Dikewood studies also covered target area cities in the New England states plus the states bordering on the Atlantic, together with West Virginia. The special case of Albuquerque was analyzed in considerable detail. Institute for Defense Analyses has analyzed the evacuation and reception problems for the Central Gulf Coast region; and RTI has prepared "crash" plans for Lincoln, Nebraska; San Diego and San Jose; and Montgomery County, Maryland, featuring evacuation and expedient shelter protection by and for the evacuees at point of destination. Stanford Research Institute has analyzed many evacuation problems, including their current study on Detroit.[32/]

Extracts and conclusions and general findings from these studies that provide the basis for feasibility and desirability conclusions are as follows:

32/ The listing includes the cities comprising OCD's "Five Cities Project," Providence, San Jose, Albuquerque, New Orleans, and Detroit.

Hudson Institute:

"No crucial elements were encountered which, with suitable substitutes, would not make evacuation feasible. Some tentative conclusions can be drawn from the plans. In a week, it appears, there is sufficient transportation to move approximately 42 million inhabitants of the northeast into reception areas in that region. With a few days time, it seems feasible for them to construct basement shelters of some value against attacks considered possible in the sixties. If preparations are made, sufficient food appears to be available from grain surpluses to survive the attack and the immediate postattack period. People are not expected to panic in situations associated with the one-week plan."33/

Dikewood Corporation:

"Among the more interesting results are those calculated for the following group of states:

New York	District of Columbia
New Jersey	Maine
Pennsylvania	Vermont
West Virginia	New Hampshire
Virginia	Massachusetts
Maryland	Connecticut
Delaware	Rhode Island

"For restricted movements within this group of states the following percentages of fatalities were found for the indicated load factors:

Maximum housing load factor	Fatalities (%)
5.7 (uniform)	not calculated
6	10
8	7
10	6

"The results support the same conclusion reached for Albuquerque, i.e., that movement out of target areas to existing shelter or houses saves large numbers of lives and further that the expected percentage of lives saved is not strongly dependent on the distribution of people in the reception areas. Thus, it became clear that further reductions in fatalities must be obtained by using better fallout shelter."34/

33/ Strategic and Tactical Aspects of Civil Defense with Special Emphasis on Crisis Situations Hudson Institute, Summary, p. 17.

34/ Specific Strategic Movement Studies, Dikewood Corporation, Final Report, May 1963, pp. 7-8. CONFIDENTIAL

The Stanford Research Institute in its research on movement planning found that readily available information was definitely insufficient for the purpose, although it appeared that resources probably would not be the dominant factor. 35/

Research Triangle Institute:

"Low probability target areas could essentially guarantee survival against fallout and the immediate effects of resource deprivation with one week of crash activity. High probability target areas could add significantly to their survival potential by a properly combined strategy of evacuation and shelter improvisation. The major liability of implementing crash plans is the cost incurred if the attack should not materialize." 36/

". . .Previous studies have concluded that 90% evacuation of metropolitan areas can be accomplished within less than one week.

"Intimately connected with dispersal strategy is the problem of improvising fallout shelter for the population. Much can be done during the crash period to complement existing shelter programs. The problem of providing shelter for evacuees can be solved in most cases. Several specific recommendations for crash shelter programs are given. Under a typical attack, it is estimated that a one-week crash shelter program alone could reduce casualties by at least thirty million."37/

35/ Alternative Hosting and Protective Measures, Stanford Research Institute, December 1968. CONFIDENTIAL

36/ Crash Civil Defense Program Planning, Final Report, Vol. I, Research Triangle Institute, 31 December 1964, pp. 6-7

37/ Crash Civil Defense Program Study, Final Report, Research Triangle Institute, April 30, 1963, pp. 1-2

The Dikewood and Hudson Institute[38] studies included the implications of evacuations on industrial production, and gross estimates of loss in Gross National Product terms. However, these studies were not concentrating on movement to actual and/or improvised shelter, concurrently with maintaining the largest feasible continuation of productive activity.

The Gross National Product is currently estimated by the Bureau of the Budget at about $2.7 billion per day, or $932 billion for calendar 1969.[39] It is advantageous to maintain GNP at the highest feasible level, whether or not an attack occurs. As a minimum, maintenance of production would keep finished goods stocks at a high level. Production maintenance would also provide opportunities for increasing supplies of "survival" type items through various conversion, priority, penalty, and incentive procedures. Besides helping to meet obvious preparedness needs, the maintenance of production and curtailment of GNP losses would strengthen the President in his confrontations with the forces that led to the evacuation in the first place.

The developing information on the availability of fallout shelter provides the basis for the estimate that it would not be necessary to travel as far as contemplated by the 1963 Hudson study, and the concurrent Dikewood studies, of the Middle Atlantic and New England urban area evacuations. These studies provided for movements as far as 300 miles in the quest for accommodation and for shelter. This generalization is derived not only from the 38 million NFSS spaces outside cities of less than 25,000 population, but also by data resulting from civil defense's 1967-68 Home Fallout Protection Surveys (HFPS) program. The HFPS program has identified residential space with a PF of 40 or higher in the homes of some two million occupants, and an additional 28 million occupants with a PF of 20 to 38. Some 97 percent of the latter is evaluated as improvable at low cost to PF 40.[40]

38/ Strategic and Tactical Aspects of Civil Defense with Special Emphasis on Crisis Situations, Hudson Institute, Chapter 5, Sections H and I, treats with political and international aspects of income and productivity losses.

39/ Bureau of Budget, News Release, Summer Budget Review, September 17, 1969.

40/ 1968 Annual Report, Department of Defense, Office of Civil Defense, p. 39.

The HFPS surveys to date have covered some 15.6 million homes. It is estimated that of the approximately 63 million dwelling units in the United States, there are some 29 million or 46 percent of the homes with basements. The South and Southwest have less than their proportionate share, and supplementary programs will be required for those areas.

The significance of the extensiveness of residential fallout shelter protection as a base for further improvisations within a home environment are suggested in Table 6, "Average Housing Load for Various Places." This table attempts to measure a commonly overlooked fact concerning U.S. housing: citizens of the United States have by far the best, and the most abundant, housing in the world. On a pre-attack standard, conceivably, our present housing could accommodate two and one-half times its present number of occupants. This calculation assumes 100 percent evacuation of SMSA's, an extreme that is believed excessive with the hazard; and inconsistent with high GNP objectives, pre-attack. A United States housing load factor of 2.5, unbearable though it may seem, even for a crisis, would approximate a housing standard roughly comparable with that of Czechoslovakia, Finland, and the U.S.S.R. The temporary "crisis" utilization of this housing expansion potential would enable many millions to be removed from blast hazard areas, while still not necessarily being forced to travel great distances. Existing dwellings and their furnishings conceivably would be utilized more intensively, without undue hardship.

This conclusion is reinforced by data from the Department of Housing and Urban Development in their planning standards for accommodation of personnel during immediate postattack periods. From a special HUD analysis, and compared with a normal peacetime standard of 3.3 persons per dwelling unit,

Table 6

Average Housing Load for Various Places[a]

Place[a]	Data for year	No. of persons per room	Load factor[b]
Argentina	1947	2.2	3.7
Bulgaria	1956	1.8	3.0
Canada	1951	0.7	1.2
Czechoslovakia	1950	1.5	2.5
Denmark	1955	0.7	1.2
Dominican Republic	1955	1.7	2.8
Finland	1950	1.5	2.5
France	1954	1.0	1.7
Germany, Federal Republic	1956	1.0	1.7
Greece	1951	1.8	3.0
Guatemala	1949	3.1	5.2
Italy	1951	1.3	2.2
Poland	1950	1.8	3.0
Puerto Rico	1950	1.4	2.3
Spain	1950	1.1	1.8
USSR	1956	1.5	2.5
UK	1951	0.8	1.3
Yugoslavia	1954	2.3	3.8
US	1960	0.6	1.0
New York State	1960	0.6	1.0
New Mexico	1960	0.8	1.3

a. Source except for last two entries is United Nations Statistical Yearbook, 1961 (Ref. 13); source for last two entries is U.S. 1960 census.

b. Load factor is measured relative to the U.S. for 1960.

it was concluded:

> "... that, on the average, 3.5 persons can be housed in each available dwelling unit without exceeding a density of 2 persons per bedroom. This is the goal for continued long-term occupancy in the recovery period after an attack. During the immediate post-attack period, however, it may be necessary to place an average of 4 additional persons per dwelling unit bringing the occupancy up to 2 persons per room, excluding kitchens."41/

Such crowding (9.5 persons per dwelling unit, compared with the "normal" 3.3 average) would be intolerable under normal peacetime conditions; indeed, many contend that the United States has a current housing crisis. There is obviously a huge difference between housing standards necessary to survival in war, and housing standards desirable for a peacetime living environment in the United States.

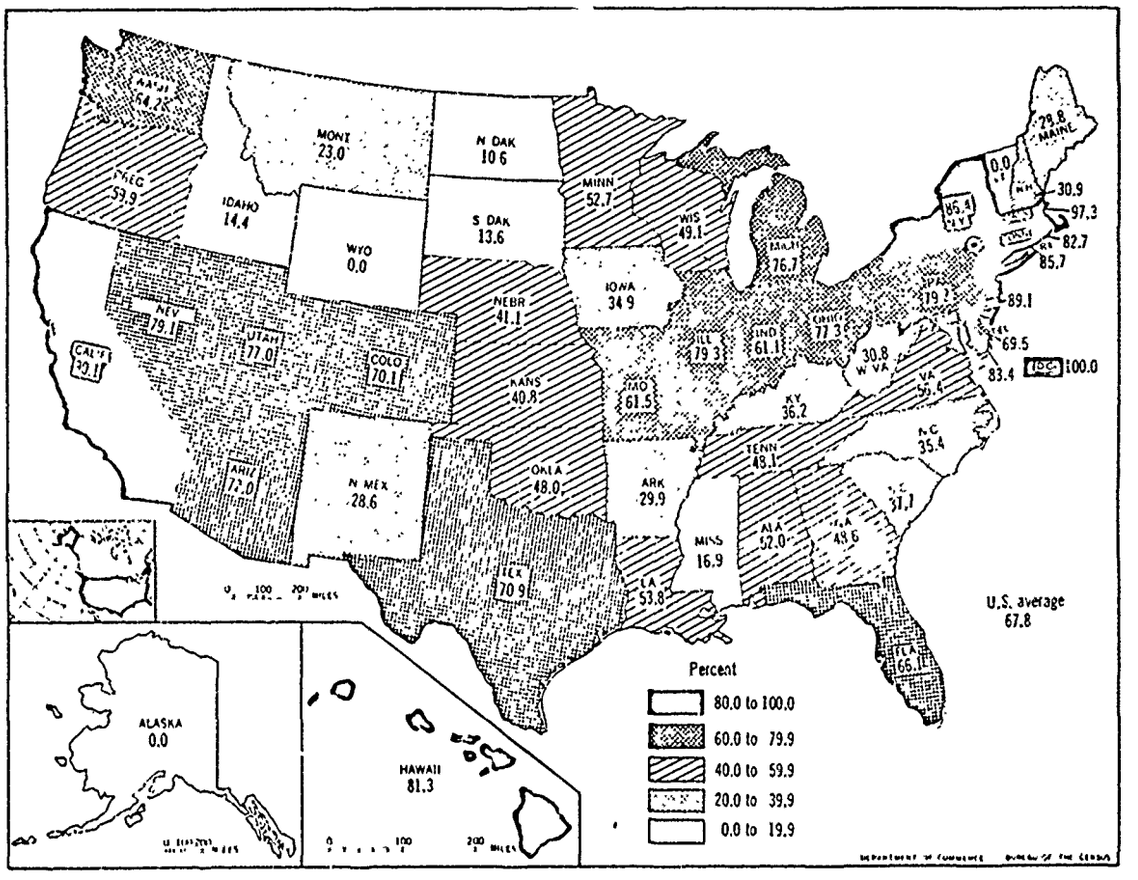
Chart 7, "Proportion of State Population in Metropolitan Counties: July 1, 1966," suggests some of the possibilities for facilitating movement of segments of the population from populated areas to achieve blast protection through distance. It is noted from Chart 7 that 67.8 percent, or about 132 millions, of the United States population are in metropolitan counties. Within those numbers, however, are some 50 million who live within a metropolitan county, but outside a central city.

Within a dispersion and shelter context, and more particularly the prospects of maintaining essential production by commuting arrangements between normal place of employment and a "dispersal" or crisis domicile, it is important to understand the difference between city statistics and metropolitan area statistics. Metropolitan area statistics include population of the central city or central cities, plus all other population within a county or counties making up a Standard Metropolitan Statistical Area (SMSA).

41/ Damage Assessment: A Manual of Procedure, Operating Instruction No. 8, U.S. Department of Housing and Urban Development, Staff Document, Revised September 1966, p. V-16.

Chart 7

Proportion of State Population in Metropolitan Counties: July 1, 1966



Of the 132 million people living in metropolitan areas in 1966, nearly 50 million lived in the 11 largest areas with a population of 2 million or more (table D). Another 50 million lived in the next 55 largest areas, with a population from 500,000 to 2 million population each. There were only 18 metropolitan areas under 100,000 population and these had a total of only 1.6 million people. Metropolitan areas between 200,000 and 2 million are growing well above the national average. On the other hand, areas below 200,000 and areas above 2 million are growing at the national average or less.

The metropolitan areas in the West are growing considerably faster than the metropolitan average of 10.9 percent. All of the SMSA's of California have gained population at the rate above the national average. The fast-growing southern California metropolitan complex of seven SMSA's surrounding Los Angeles shows an increase of 19.4 percent, adding 1.8 million persons to its 9.2 million inhabitants in 1960.

Source: "Estimates of the Population of Counties and Metropolitan Areas, July 1, 1966, A Summary Report," Population Estimates and Projections, Current Population Reports, U.S. Department of Commerce, Bureau of the Census, Series P-25, No. 427, July 31, 1969, p.4.

If homes with basements were uniformly distributed the problems of nearby living space, including home fallout shelter and commuting to a central city, appear quite manageable. As shown in the tabulation below, by "doubling up" in the urban fringe, the central city population could remain within the SMSA. Except for OCD Region 5, the doubling up ratio is uniform for all OCD regions. By "tripling up" the entire SMSA population conceptually could be accommodated in the homes of the 68,000,000 population of the non-metropolitan counties.

Table 7

1960 SMSA Resident Population

Shown by Central City and Urban Fringe Components

	Resident Population		
OCD Region	Central City	Urban Fringe	SMSA
1	13,736,898	12,796,333	26,533,231
2	10,568,827	12,121,358	22,690,185
3	5,101,570	5,154,452	10,256,022
4	10,131,688	9,166,812	19,298,500
5	6,631,410	2,693,613	9,325,023
6	3,580,312	2,524,619	6,104,931
7	6,553,993	8,778,527	15,332,520
8	1,418,535	1,425,822	2,844,357
Cont. U.S.	57,723,233	54,661,536	112,384,769
Percent	51.4%	48.6%	

Source: Emergency Operations Systems Development, Movement to Shelter, Phase I Analytical Report, R. W. Hubenette and G. S. Crane, Stanford Research Institute, August 1965, p. 25.

Further, it does not appear necessary to accept the inconvenience and discomfort of high crowding factors until an attack appears imminent because prior to such an event there may be time, through expedients, to improve the more suitable basement and non-basement residences and public buildings. NFSS spaces, and improvised expedient fallout shelter, would be utilized only as warranted by overt indication of impending attack.

By no means is it intended to suggest, from housing availability and expedient shelter feasibility, that a dispersion program would be acceptable or wise under any or all conditions of international tension. Indeed, it may be a step of last resort for the Chief Executive. A movement to shelter program will at best present difficulties and could be costly to implement. Civil defense experiences with program acceptability lead to anticipations of staunch opposition, regardless of the program. Vast differences exist between practicalities of dispersion for several cities or a region, and a total national program. At this early stage, legitimate questions can and should be raised as to its desirability as a planning objective. It is appropriate, therefore, to consider whether or not the United States economy can function under conditions of disruption and great hardship, even with the availability of austere housing resources.

No directly applicable analogies exist with regard to the kind of dispersal contemplated, but some historical examples are relevant. There is comparability in program magnitude with the 1941-42 achievement of the Soviet Union in removing much of its industrial capital and labor force to the safety of the Ural Mountains, while suffering millions of casualties to the Nazi advance to Moscow.

Other historical evidences indicate that with the proper leadership, and for an inspiring cause, a nation under stress will respond beyond all normal expectations. Among the noteworthy cases are the achievements of Nazi Germany under continuing bombing attack. Despite concerted bombing of fighter assembly factories, and components such as ball bearings and engines, as primary target objectives, German propeller fighter production steadily increased to a peak in July-August of 1944. Concurrently, a jet engine aircraft was developed. During this same period, Germany developed and placed in series production two significantly different designs of "terror" weapons--the unmanned sub-sonic V-1 flying bomb and the supersonic, liquid-fueled ballistic missile, the V-2. Both these revolutionary weapons competed for the same resources necessary for aircraft production. After the war, but in the absence of a crisis, it took the United States many years to develop the "next generation" of V-1 type pilotless aircraft such as "Matador" and "Snark." About ten years were required for the United States

to duplicate V-2 performance standards, even with the help of German scientists, and to surpass the German standards of reliability and accuracy with surface-to-surface missiles such as "Corporal," "Pershing," and "Thor."

More current examples of national effectiveness under great stress, but with far less complex economies than Germany, are North Vietnam and South Vietnam. The proportionate and actual losses on both sides from two decades of conflict are among the most severe of all history and yet they continue to fight.

Leadership and constructive national support typical of past emergencies in the United States will necessarily be assumed. A Presidential decision to encourage, to stimulate, or to order dispersal of population from areas of greatest danger would be accompanied by TV and other mass media explanations as to how and why such steps would reduce loss of life if an attack occurs. Sound foundations can be constructed on which to base popular support for unprecedented decisions. Nevertheless, the decision will not be simple, or made easily, and it may have unpredictable consequences.[42/]

As will be documented below, there are large fractions of our national capacities, stocks, and resources outside central city boundaries, and outside SMSA's. Our pre-attack capabilities for transportation of people and commodities are so extensive and diversified as to leave little doubt but that ample physical resources exist to support an urban population relocation and to maintain life, health, and productivity of both evacuees and hosts. Early and forthright consideration of the implications of a population relocation posture to a postattack environment are a necessary part of an analysis. Assuming an attack occurs, could life, health, and productivity still be sustained? At what standard of living level? These aspects are introduced now because their consideration facilitates understanding of the existing resource distributions that make a population dispersion decision feasible and attractive from the perspective of physical, industrial, and economic resources alone.

42/ See Strategic and Tactical Aspects of Civil Defense with Special Emphasis on Crisis Situations, Hudson Institute, especially Chapter V, for extensive treatise on political and diplomatic aspects of a dispersion decision.

Accepting, after a careful review, the conclusions of the studies documented early in this chapter, that it is possible to disperse a population, and by the dispersal increase the number of individuals likely to survive a massive attack, would such a dispersal aid or inhibit national survival in the postattack period? Little industrial capacity is mobile, at least in a short-run period of weeks. The question involves two elements: (a) under-utilization, reserve, or emergency expansion capability of existing facilities; and (b) city and non-city distribution of industrial capacity.

To take the emergency expansion element first, it is important to appreciate that the United States economy generally operates at something less than full capacity. Even the so-called "full" capacity is substantially less than emergency, short-run capacity. Table 8, "Full and Emergency Capacity to Output Ratios for Selected Industries," was developed by the Institute for Defense Analyses, and is responsive to the point. Some 78 industrial sectors are shown. Although there are many exceptions to this and other generalizations, it appears reasonable to state that a typical reserve factor to full capacity is about 20 percent. In an emergency, production output can be doubled.

The Institute for Defense Analyses tabulations in Table 8 are consistent with a related evaluation prepared by Dr. Sidney Winter of the Rand Corporation and presented to the Committee on Government Operations in 1961. Dr. Winter's findings are encapsuled in Table 9, "Percent of Capacity Output Required in Various Industries to Meet Austere Consumption Requirements," and it is reproduced below, together with Dr. Winter's commentary.

Table 8

Full and Emergency Capacity to Output Ratios for Selected Industries

Sector	Capacity/Output	
	Full	Emergency
1. Livestock and livestock products	1.074	1.074
2. Other agricultural products	1.350	2.043
3. Forestry and fishery products	*	*
4. Agricultural, forestry & fisheries services	*	*
5. Iron & ferroalloy ores mining	2.786	2.786
6. Nonferrous metal ores mining	1.078	1.078
7. Coal mining	1.301	1.301
8. Crude petroleum & natural gas	1.257	1.257
9. Stone & clay mining & quarrying	1.116	1.116
10. Chemical & fertilizer mineral mining	1.051	1.051
11. New construction	1.072	3.002
12. Maintenance & repair construction	1.043	2.920
13. Ordnance & accessories	1.089	2.075
14. Food & kindred products	1.122	1.987
15. Tobacco manufactures	1.094	1.641
16. Broad & narrow fabrics, yarn, thread mills	1.110	2.026
17. Miscellaneous textile goods, floor coverings	1.183	2.130
18. Apparel	1.153	2.766
19. Miscellaneous fabricated textile products	1.183	2.130
20. Lumber & wood products, except containers	1.300	2.605
21. Wooden containers	1.048	2.520
22. Household furniture	1.145	2.640
23. Other furniture & fixtures	1.114	2.242
24. Paper, allied products, except containers & boxes	1.112	1.683
25. Paperboard containers and boxes	1.112	1.683
26. Printing & publishing	1.097	2.637
27. Chemicals & selected chemical products	1.080	1.698
28. Plastics & synthetic materials	1.197	2.208
29. Drugs, cleaning & toilet preparations	1.066	2.145
30. Paint & allied products	1.314	2.495
31. Petroleum refining & related industries	1.100	1.140
32. Rubber & miscellaneous plastics products	1.212	2.318
33. Leather tanning & industrial leather products	1.252	2.515
34. Footwear & other leather products	1.219	2.635
35. Glass & glass products	1.154	1.731
36. Stone & clay products	1.238	2.244
37. Primary iron & steel manufacturing	1.538	1.768
38. Primary nonferrous metals manufacturing	1.190	1.921
39. Metal containers	1.197	2.225

* Potential output assumed unlimited.

Source: E. S. Pearsall, "Capacity Scarcities Following Attacks on Industry--Some Tentative Results with a Rudimentary Model, " from Proceedings of the Civil Defense Systems Evaluation Research Conference, October 14-17, 1968, at The Institute for Defense Analyses, Arlington, Virginia, U.S. Department of the Army, Office of the Secretary of the Army, Office of Civil Defense, Vol. II, p. 12.

Table 8 (Continued)

Full and Emergency Capacity to Output Ratios for Selected Industries

Sector	Capacity/Output	
	Full	Emergency
40. Heating, plumbing & fabricated str. metal products	1.150	2.496
41. Screw machine products, bolts, nuts, etc.	1.447	2.682
42. Other fabricated metal products	1.392	2.718
43. Engines and turbines	1.087	2.173
44. Farm machinery & equipment	1.196	2.320
45. Construction, mining, oil field machinery & equipment	1.087	2.222
46. Materials handling machinery & equipment	1.087	2.280
47. Metalworking machinery & equipment	1.196	2.395
48. Special industry machinery & equipment	1.087	2.395
49. General industrial machinery & equipment	1.088	2.190
50. Machine shop products	1.095	1.971
51. Office computing & accounting machines	1.087	2.394
52. Service industry machines	1.086	1.952
53. Electric transmission & distribution equip.	1.252	2.489
54. Household appliances	1.189	2.235
55. Electric lighting & wiring equipment	1.253	2.504
56. Radio, television & communication equipment	1.480	2.958
57. Electronic components & accessories	1.252	2.504
58. Misc. electrical machinery, equipment & supplies	1.251	2.580
59. Motor vehicles & equipment	1.391	1.691
60. Aircraft & parts	1.178	2.356
61. Other transportation equipment	1.363	2.488
62. Professional, scientific & control instruments	1.136	1.976
63. Optical, ophthalmic, photographic equipment, etc.	1.136	1.474
64. Miscellaneous manufacturing	1.088	1.792
65. Transportation & warehousing	1.000	1.000
66. Communications, except radio & T.V.	1.000	1.000
67. Radio and T.V. broadcasting	*	*
68. Electric, gas, water & sanitary services	1.000	1.000
69. Wholesale & retail trade	*	*
70. Finance & insurance	*	*
71. Real estate & rental	*	*
72 Hotels & lodging places; personal & repair serv., except auto	*	*
73. Business services	*	*
74. Research & development; Government enterprises	*	*
75. Automobile repair & services	7.000	6.000
76. Amusements	*	*
77. Medical, education services & nonprofit organizations	1.148	1.497
78. Imports of goods and services	1.000	2.506

*Potential output assumed unlimited.

Source: E. S. Pearsall, "Capacity Scarcities Following Attacks on Industry--Some Tentative Results with a Rudimentary Model," from Proceedings of the Civil Defense Systems Evaluation Research Conference, October 14-17, 1968, at The Institute for Defense Analyses, Arlington, Virginia, U.S. Department of the Army, Office of the Secretary of the Army, Office of Civil Defense, Vol. II, p. 13.

Table 9

Percent of Capacity Output Required in Various Industries
To Meet Austere Consumption Requirements
(Figures for 1958)

Industry	Percent of capacity
1. Drugs, medicines	51
2. Pulp and paper	51
3. Textiles	45
4. Grain mills	43
5. Tobacco manufactures	43
6. Apparel	41
7. Leather	41
8. Meatpacking	40
9. Petroleum	40

Source: Sidney G. Winter, Jr., Rand Corporation, testimony in "Civil Defense--1961," hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 87th Cong., 1st sess., August 1,2,3,4, 7,8, and 9, 1961, p. 314.

Austere consumption requirements are defined as a level of real personal consumption expenditures per capita just under the actual level for 1929, which in turn was about two-thirds of the per capita consumption expenditures for 1958. Since 1958, of course, personal standards of living have increased substantially over the level of 11 years ago. The survival reserve would therefore be even larger than shown.

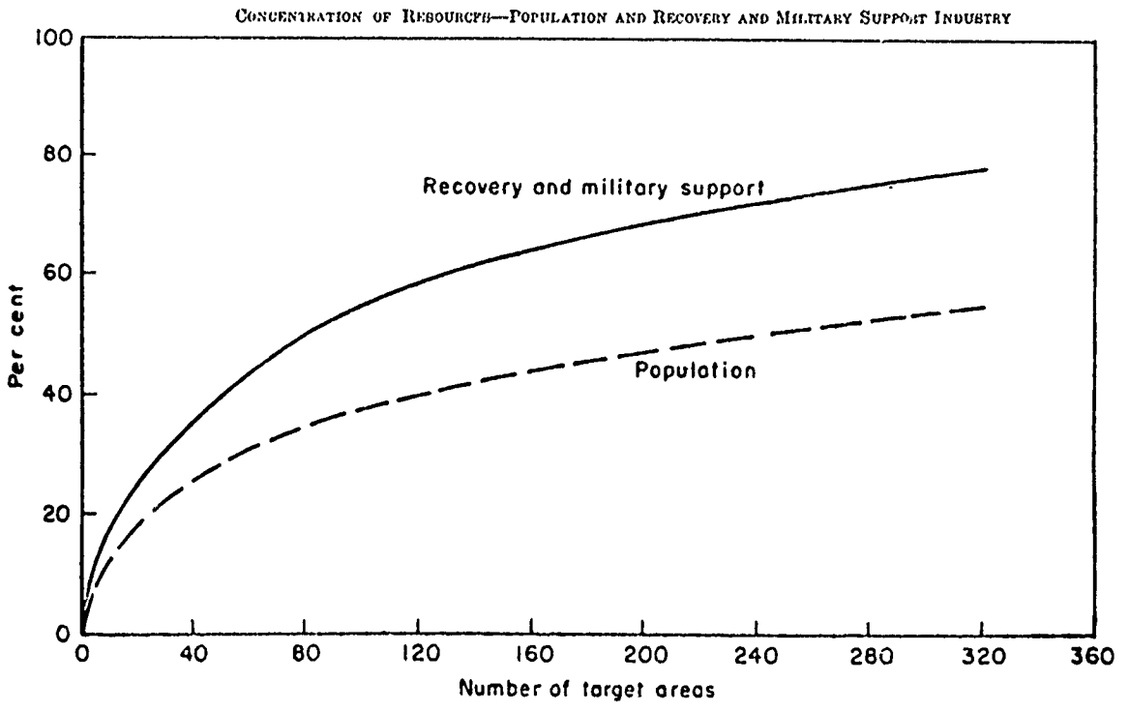
Dr. Winter went on to state that:

> "The requirements for the output of the various industries were computed by the technique of input-output analysis, and both the direct requirements for output delivered to consumers, and the indirect requirements generated by other industries are included.
>
> "... The general conclusion is that for almost all industries under 50 percent of capacity is needed to support the full population at about the 1929 level.
>
> "Another way of putting it is to say that as long as the ratio of suviving capacity in most industries to surviving population is not much less than half the prewar ratio, support of the population at the 1929 level of consumption or better should be possible." 43/

43/ Civil Defense--1961, p. 315.

Chart 8, "Concentration of Resources--Population and Recovery and Military Support Industry," was also prepared by Dr. Winter. Paradoxically, the chart shows both a high concentration of Recovery and Military Support Industry and a wide dispersion of the remainder of such industry. In this chart, the target areas are ranked first by population. Thus, 80 target areas (SMSA's) contain about 35 percent of the total population and 50 percent of the recovery and military support industry. For the less heavily populated areas, the population to industry co-location relationship tends to uniformity.

Chart 8



Source: "Civil Defense--1961," hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 87th Cong., 1st sess., August 1, 2, 3, 4, 7, 8, and 9, 1961, p. 320. Sidney G. Winter, Jr., Rand Corporation.

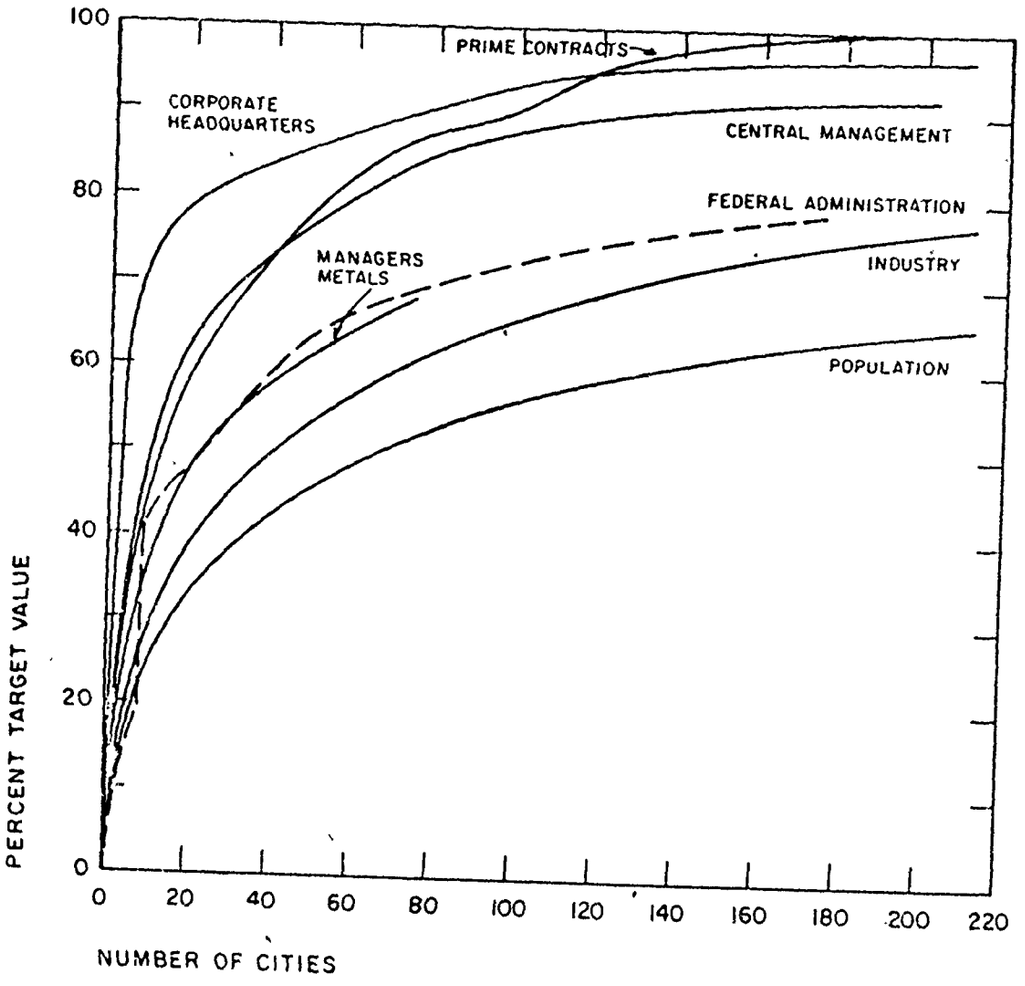
The recovery and military support industries tend to be heavier and to require more equipments than the "survival" goods industries. Survival industries are less heavily concentrated. The comparable chart on survival industries shows only 45 percent of survival industry in the 80 largest target areas comprising 35 percent of the population, and the same trend for uniform co-location of the remaining capacity with population.

Chart 9, "Distribution of Values in Metropolitan Areas," is prepared on more current data. It is consistent with the earlier charts showing a high degree of concentration of industry and management with population up to the largest 100 cities. Thereafter, the curves tend to be parallel. This chart is included to illustrate the fact that many concentration elements are also mobile. For example, "Federal Administration" can be dispersed, as can "Central Management," and "Corporate Headquarters." Key individuals in these categories already account for much of the inter-city residential movement in our country.

Chart 10, "Core and Contiguous Counties 50% Population Base," was prepared by Mr. Abner Sachs of the Institute for Defense Analyses as a part of his presentation at the Civil Defense Systems Evaluation Research Conference in 1968. This chart also suggests feasibility of a sustained dispersal and shelter policy, with commuting of essential workers. Retail trade is almost perfectly co-located with population, but wholesale trade is only concentrated to the extent of 70 percent in 50 percent of the population. A sound basis exists for modification and shifting in distribution patterns by building on an existing system.

Chart 10 also illustrates that manufacturing establishments, and more particularly the larger establishments with 100 or more employees, are also widely distributed, perhaps more than commonly realized. Thus, in the core and contiguous counties accounting for 60 percent of the population, there are about 65 percent of the manufacturing establishments of 100 or more employees. If measured by other terms, such as value added, or shipments, the degree of concentration would be somewhat higher.

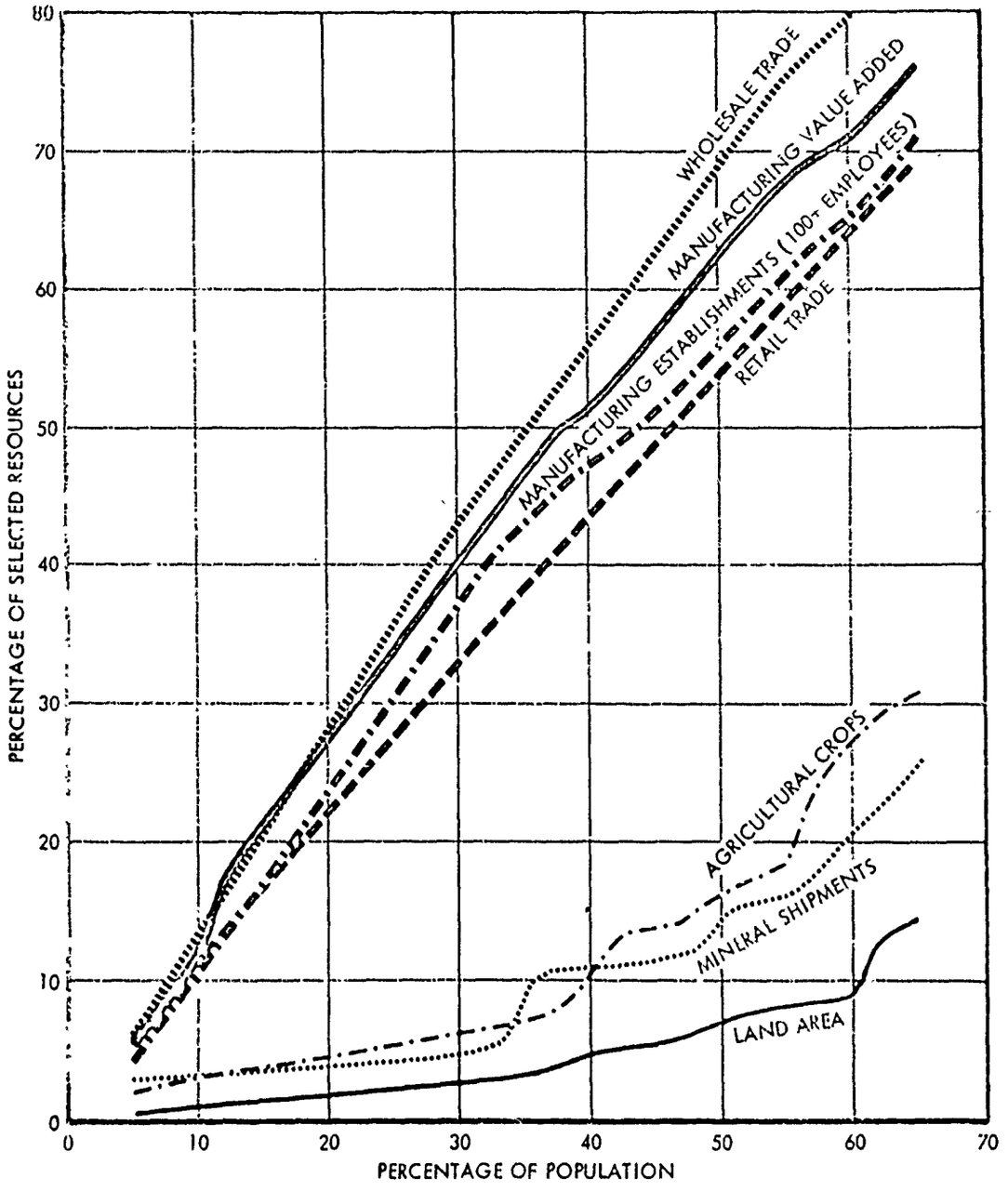
Chart 9



Distribution of Values in Metropolitan Areas.

Source: R. K. Laurino, National Entity Survival Following Nuclear Attack, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 209.

Chart 10



Core and Contiguous Counties, 50% Population Base

Source: A. Sachs, "The Economic Structure of the United States Using the County as a Functional Base," from Proceedings of the Civil Defense Systems Evaluation Research Conference, October 14-17, 1968, at The Institute for Defense Analyses, Arlington, Virginia. Volume II, p. 13.

On the other hand, the chart makes clear that a vast amount of manufacturing capacity and know-how is widely scattered throughout the United States, with much of it located in the less heavily populated areas.

Significant quantities of industrial production capacity and even greater capability exist outside the major metropolitan areas. In terms of blast hazard, industrial production facilities are already widely dispersed. Aggregative statistical techniques such as those associated with SMSA and county totals tend to lead to expectation of higher concentration and higher destruction from blast effects than the detailed procedures of damage assessment measure.

Without exception, all known studies that have addressed comprehensively the problem of postattack viability and recovery have concluded that the United States postattack mixes of population and industry would be able to maintain production levels, per capita, not unlike those of World War II. In fact, the per capita production of essentially all such studies, including the first postattack year or two, estimated per capita consumption options far in excess of many, if not most, of the world's inhabitants today. For the first postattack year, therefore, and measured crudely in GNP per capita, the United States GNP standards could be expected to be comparable with those of Greece, Portugal, Bulgaria, Romania, Spain, or Yugoslovia in 1968.

Per capita output at these levels would enable the United States to maintain a leadership role as a producer of the world's goods. This conclusion is suggested from an examination of Table 10, prepared by the United States Arms Control and Disarmament Agency in November of 1968, entitled "Ranking of Major Countries According to GNP and Military Expenditures, 1966." To take one set of calculations, for example fatalities over 70 million, there would remain a postattack population of about 130 million, or the approximate population of the United States at the time of its entry into World War II. If there is any validity to per capita production studies described more fully below, a considerable basis exists for projecting that the United States Gross National Product, postattack, could be sufficiently large as to enable it to rank within the first ten countries.

Table 10. RANKING OF MAJOR COUNTRIES ACCORDING TO GNP AND MILITARY EXPENDITURES, 1966

(Amounts at current prices and purchasing power equivalent dollars)

COUNTRY	GROSS NATIONAL PRODUCT				MILITARY EXPENDITURES	
	Total		Per Capita			
	Rank	Bil $	Rank	Dollars	Rank	Bil $
United States*	1	$747.6	2	$3,769	1	$63.3
Soviet Union*	2	357.0	19	1,531	2	47.0
Japan	3	199.4	14	2,017	8	1.9
West Germany	4	144.1	7	2,398	6	4.9
United Kingdom*	5	121.7	11	2,223	3	6.9
France*	6	109.3	12	2,212	5	6.3
Mainland China*	7	80.0	58	104	4	6.5
Italy	8	72.7	21	1,400	7	2.1
Canada	9	58.9	3	2,940	10	1.8
India	10	46.8	59	93	9	1.9
Poland	11	33.2	24	1,047	11	1.8
Australia	12	32.4	4	2,810	14	1.2
Brazil	13	32.1	38	386	17	1.0
Spain	14	32.0	25	1,003	18	1.0
Sweden	15	30.0	1	3,839	13	1.3
East Germany	16	28.3	18	1,658	15	1.1
Netherlands	17	24.1	16	1,933	16	1.0
Czechoslovakia	18	23.8	17	1,671	12	1.4
Argentina	19	21.5	26	946	28	.4
Belgium	20	21.0	13	2,207	19	.9
Mexico	21	20.3	36	460	44	.2
Yugoslavia	22	18.2	27	922	20	.8
Romania	23	16.6	30	867	23	.5
Switzerland	24	16.5	5	2,755	25	.4
Austria	25	14.4	15	1,974	39	.2
Hungary	26	12.0	22	1,179	31	.3
Denmark	27	11.8	6	2,458	29	.3
Pakistan	28	10.9	60	93	26	.4
Turkey	29	10.5	41	328	24	.5
Finland	30	10.4	10	2,252	43	.2

* Denotes country possessing nuclear weapons.

Source: World Military Expenditures and Related Data, Calendar Year 1966 and Summary Trends, 1962-1967, United States Arms Control and Disarmament Agency, Economics Bureau, Research Report 68-52, December 1968, p. 20.

Speculations have been publicized that life in a postattack world would be impossible, and that survivors would be inevitably doomed. This fatalism has been accepted as fact by many persons. It raises an unfounded "hard question" of the desirability of increasing the numbers of survivors from immediate effects. An argument conceivably could be advanced, for example, against programs increasing the ratio of surviving population to industrial capacity if the surviving industrial capacity is insufficient to maintain life. The data below show there is no basis for this unqualified speculation.

Chart 11, "Survival of the United States in 1975--Historical Significance," is taken from a study of the Engineers Strategic Study Group, U.S. Army, and compares a postattack United States in the year 1975 with Germany in 1939. The attack contemplated would reduce the level of the population of the United States to about 130 million. The survivors are estimated to have available an industrial capacity that could permit a total production of $500 billion--about the level produced in 1961. These figures compare favorably with the situation in pre World War II Germany. On a per capita basis, U.S. production postattack could be several times greater than that in Germany in 1939.

The next chart, "Utilization of Industry--1975," prepared by the Engineers Strategic Study Group (SSG) as a part of the same study, suggests that the postattack economy would not only be able to meet immediate personal consumption needs, but have additional capability for allocation to postattack needs, whether war purchases or recovery or recuperation expenditures.

While lifesaving programs need no special justification, there are compelling economic reasons for increasing the proportionate numbers of surviving population to industry. These are suggested by Chart 13, "Comparison of 1975 Residual Labor Force and Industry Under 1975 'Massive' and 'Moderate' Attacks Together with Alternative Labor Utilization Data." This chart also illustrates further the generalization made earlier concerning the existing dispersion of industry insofar as blast effects and blast vulnerability are concerned. On a national basis, industrial capacity is difficult to destroy.

RESOURCES		EQUIVALENT YEAR IN HISTORY
UNITED STATES		
POPULATION SURVIVING –	130 MILLION	1939
INDUSTRY (GNP) SURVIVING –	$500 BILLION	1961
GERMANY		
POPULATION –	78 MILLION	1939
INDUSTRY (GNP) –	$58 BILLION	1939

Chart 11. Survival of the United States in 1975--Historical Significance

Source: L. B. Addington, Postattack Viability of the United States-1975, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 242.

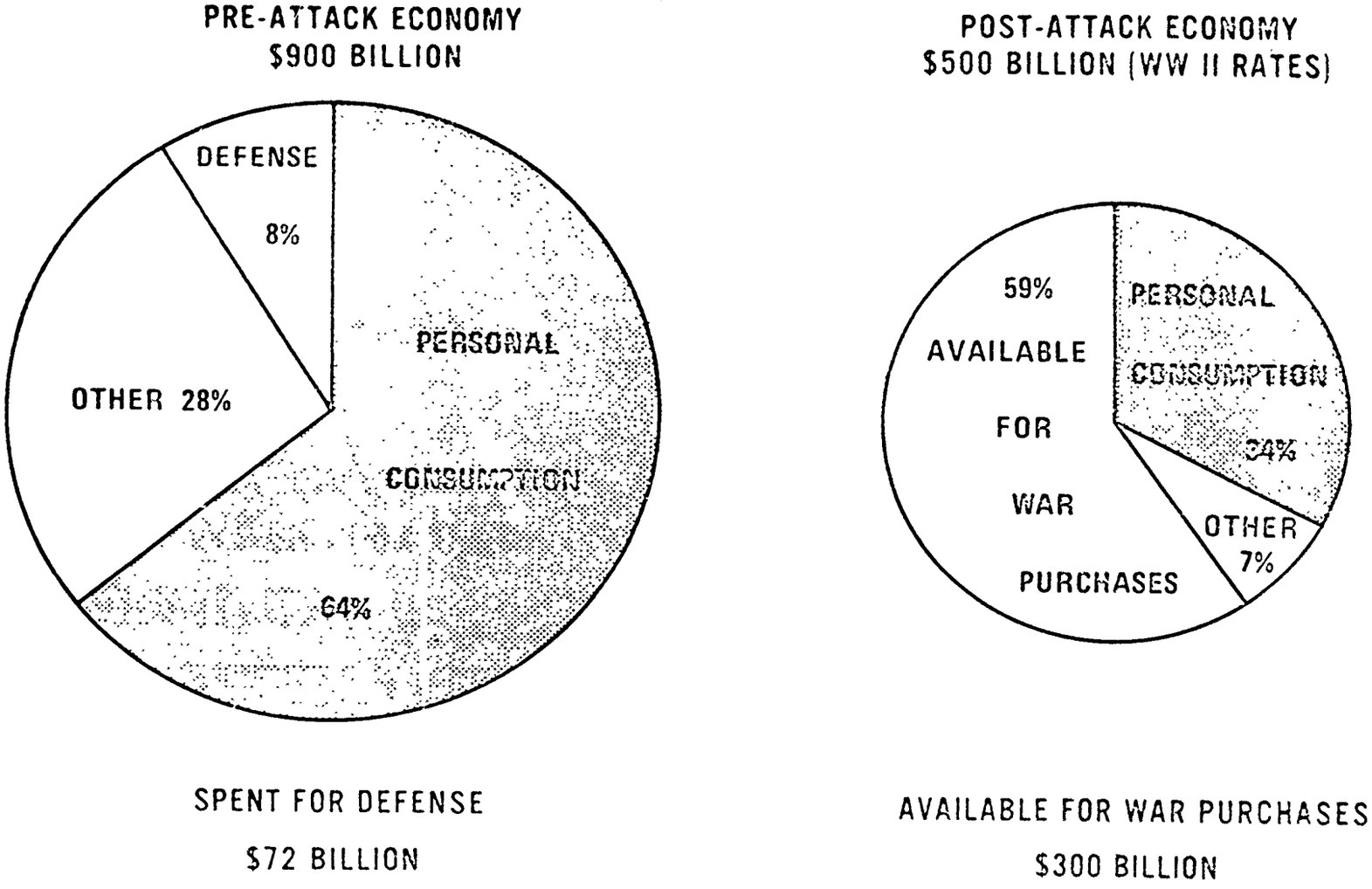


Chart 12. Utilization of Industry - 1975.

Source: L. B. Addington, Postattack Viability of the United States-1975, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 241.

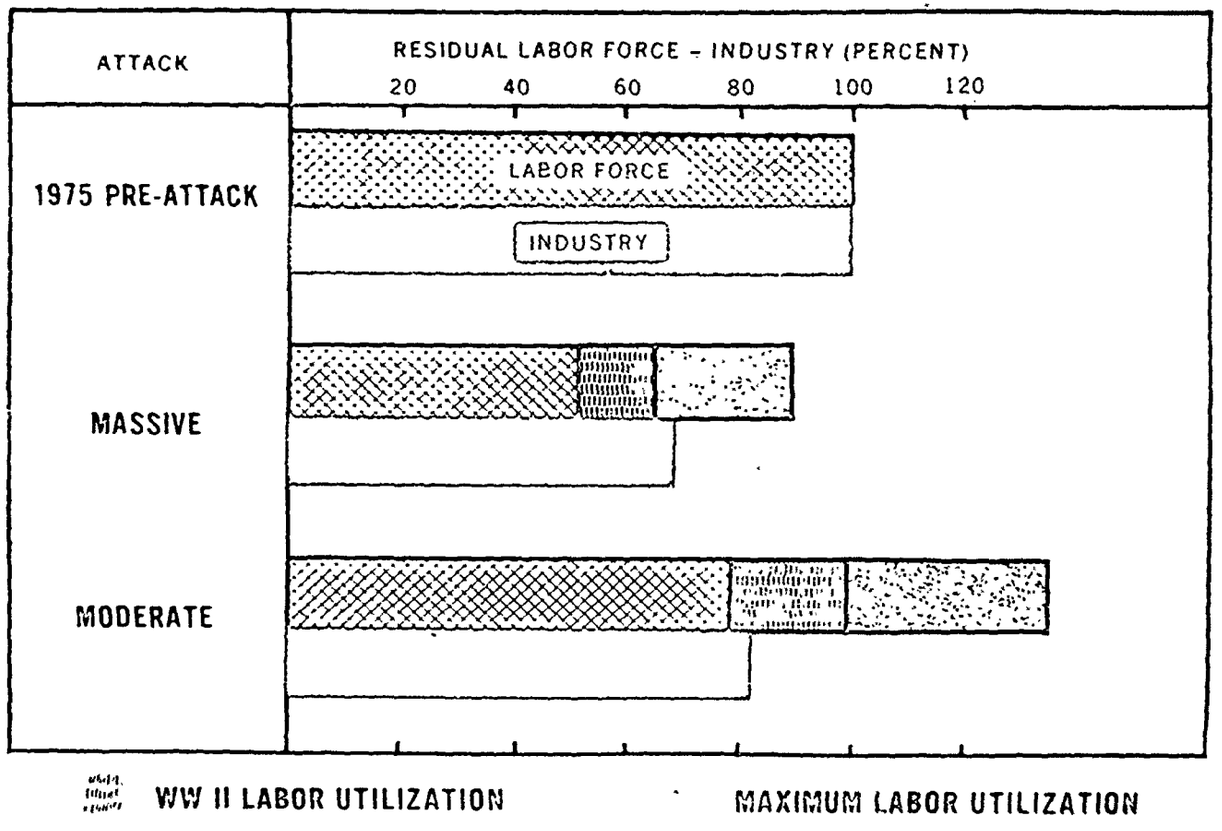


Chart 13. Comparison of 1975 Residual Labor Force and Industry Under 1975 "Massive" and "Moderate" Attacks Together with Alternative Labor Utilization Rates

Source: L. B. Addington, Postattack Viability of the United States-1975, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 239.

These charts and studies tend to the conclusion that industrial capacity will withstand attack in greater proportions than labor force. Chart 13 in particular indicates that the constraining factor for post-attack viability and recovery will not be industrial capacity but available labor force. The capital resources will tend to be available with which to achieve survival and to pursue recovery.

Similar conclusions are suggested from analysis of Chart 14, "Impact on Production Capacity of the CIVLOG and UNCLEX Attacks." Chart 14 already has taken into consideration and discounted, through utilization of the "Capacity Per Capita" bars on the right half of the chart, the numbers of fatalities resulting from the CIVLOG and UNCLEX attacks. It is based on pre-attack per capita relationships. These relationships tend to understate the total capacity available, as they do not take adequately into consideration the additional concept of "full" and "emergency" capacity, identified by Dr. Winter of the Rand Corporation, and the Institute for Defense Analyses studies, and referred to earlier. It is also noted that the per capita manufacturing capacity estimates shown in this chart are for large manufacturing facilities, and these are more heavily concentrated in large cities than the more widespread, and smaller, manufacturing plants.

Mr. R. K. Laurino of Stanford Research Institute has also shown in one of his studies, that postattack and undamaged industrial capacity may not be fully utilized because of an insufficient labor force. Mr. Laurino introduces the important concept of restricting radiation exposure of the surviving labor force, and alternative reallocations of the labor force within the same plant or within a Standard Metropolitan Statistical Area to achieve that goal. His calculations indicate that the undamaged plant capacity may be utilized fully only by exposing the labor force to undesirable levels of radiation. Another way of interpreting these findings, as illustrated in Chart 15, "Availability of Industry," is to regard them as elements of an even stronger case for protecting a larger fraction of the population against blast effects, as well as fallout effects. The labor force is essentially an inseparable element of the total population, and is vital to production.

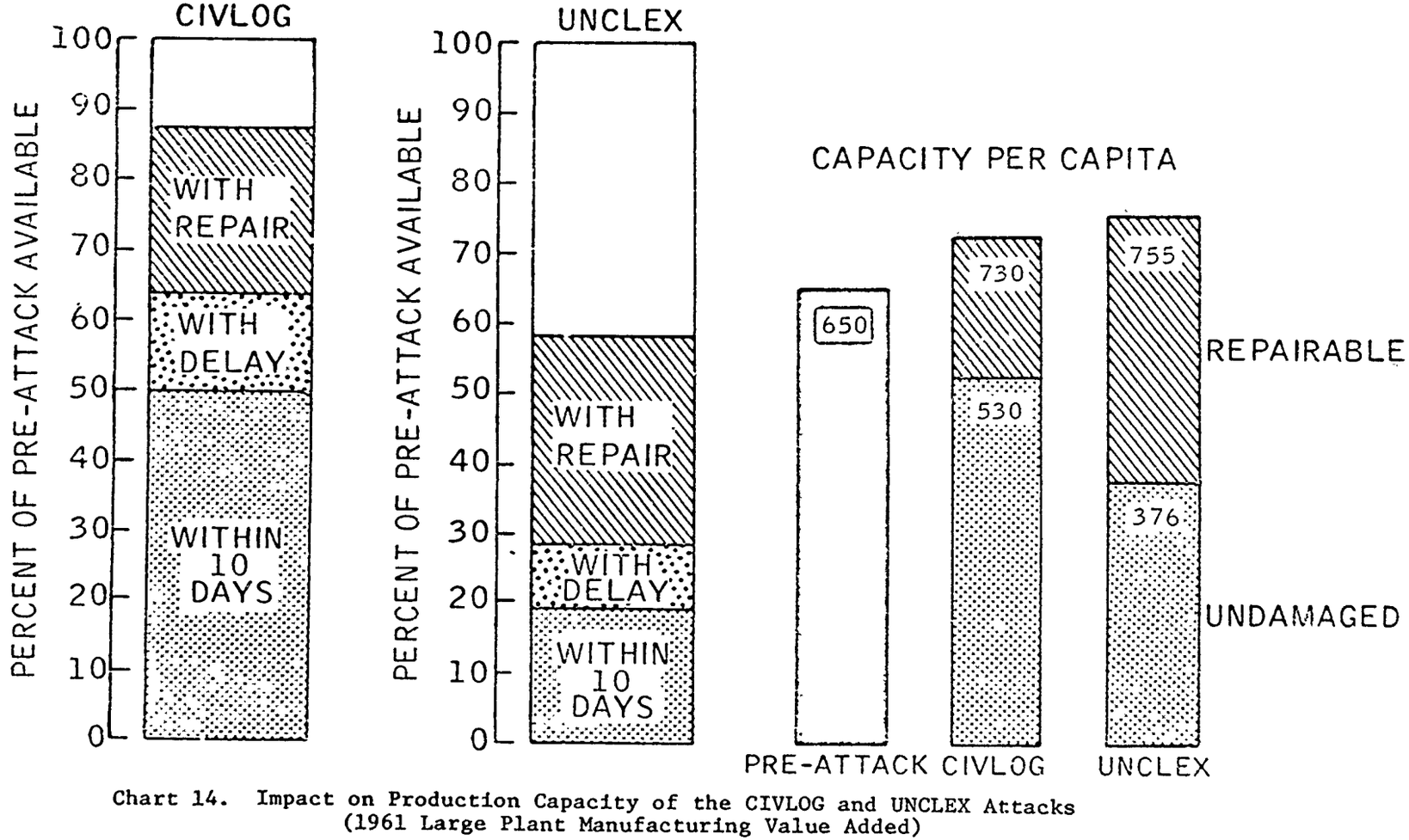


Chart 14. Impact on Production Capacity of the CIVLOG and UNCLEX Attacks
(1961 Large Plant Manufacturing Value Added)

Source: J. C. Pettee, Example Attacks, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 18.

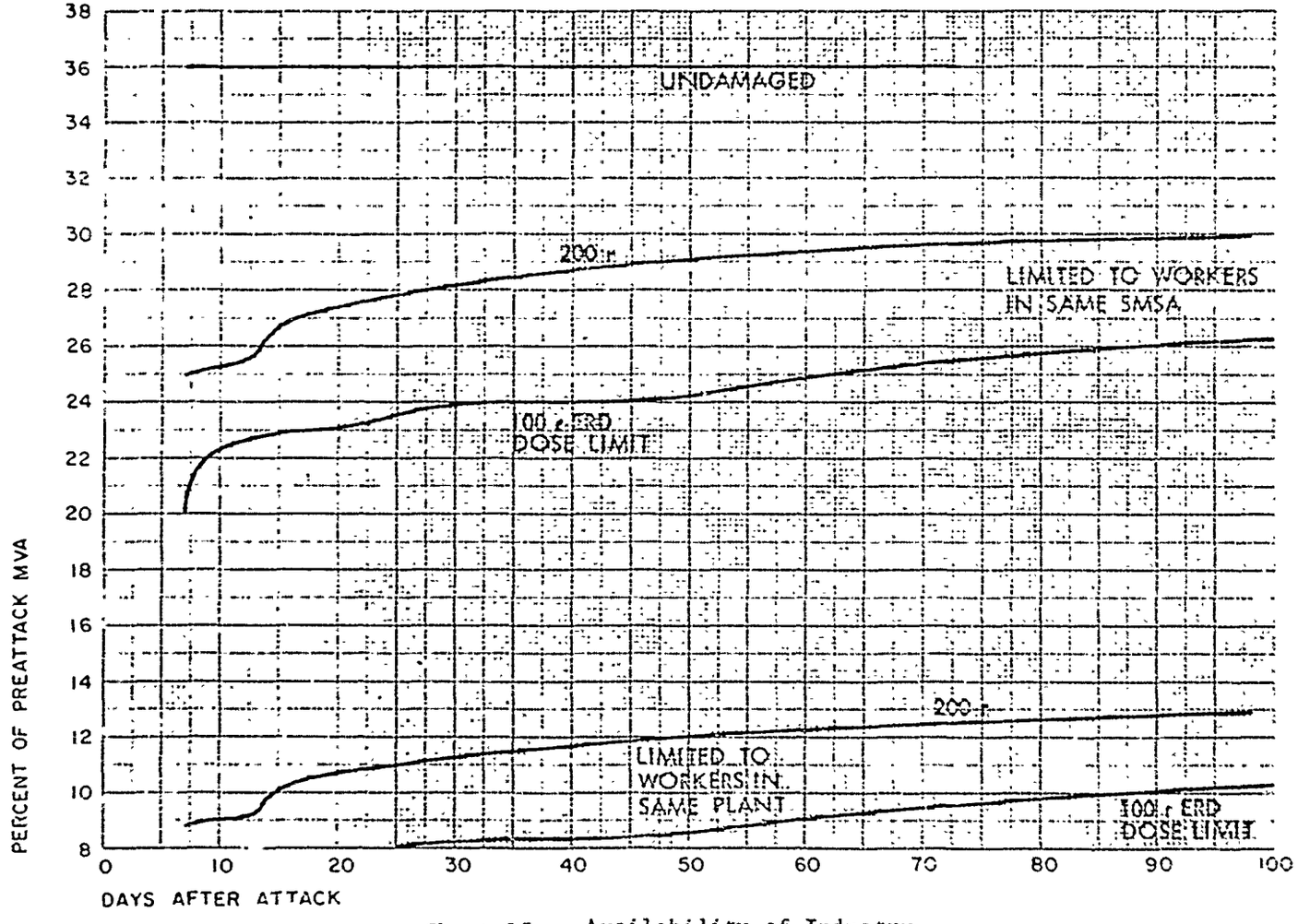


Chart 15. Availability of Industry.

Source: R. K. Laurino, National Entity Survival Following Nuclear Attack, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 215.

Chart 16, "Total Value Added Per Population Surviving," prepared by the Institute for Defense Analyses, indicates that a surviving economy in the 1975 period would be able not only to meet survival needs, and recovery needs, but also to exceed the 1962 per capita "value added" production levels. These calculations were described by the referenced IDA authors as valid for different levels and types of attack. Postattack alternatives from two attack types regarded of special planning significance for 1975 were attacks "A" with a surviving population of about 180 million, and "B" with about 137 million survivors. Type "A" attacks are counterforce or military attacks. Type "B" attacks divert part of the force to population targets. Relatively small attacks, such as indicated in the dashed line--B: 2--cause disproportionate difficulties. These calculations again demonstrate the substantial redundancy of physical capital in the American economic system, and the expectation that levels of population survival, management capabilities, and labor force utilization appear to be the primary constraints on the achievable level of total postattack economic activity. Postattack industry capacity is not the constraint.

It is pertinent to note also that existing household per capita stocks of consumer durables are estimated at $6,300, in 1963 dollars, or close to two years per capita production. This does not include manufacturers' inventories of all items, as well as finished goods which have left the manufacturer and are in the distribution chain. The household durable inventories are particularly sensitive to population relocation planning because the inventories already are distributed to the various homes and dwelling units throughout the United States. Construction value is the most significant dollar figure, but the balance of about $2,000 per capita (1963 dollars)[44/] in consumer durables (clothing, appliances, furniture, tools) is a tremendous asset.

Chart 17, "Estimated National Food Supply, July 1, 1967," supplements the consumer durable inventories by estimating the various food resources at mid-summer. Mid-summer supplies are the lowest supplies of food during

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44/ Inventory Measures of Consumer Durables by Census Region, Work Unit 4115B, Jack Faucett Associates, December 1968, pp. 3-8.

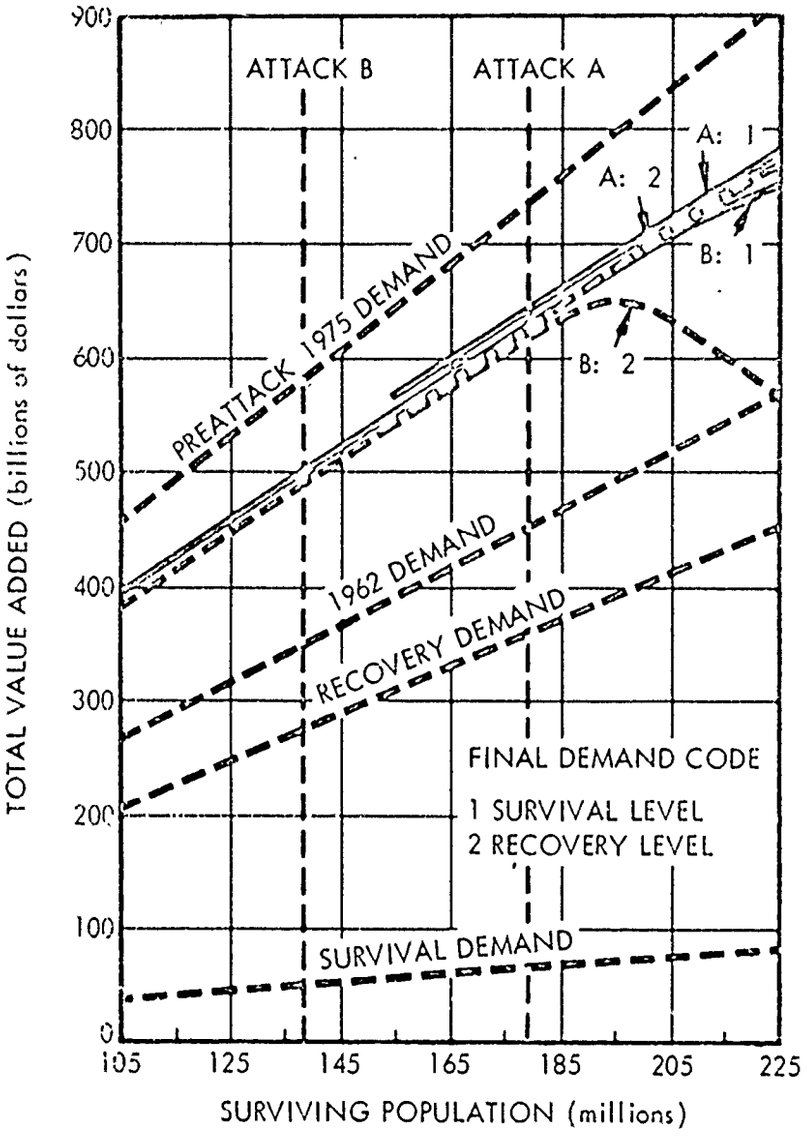

Chart 16. Total Value Added Per Population Surviving.

Source: L. J. Bickley and E. S. Pearsall, Estimates of the Potential of the United States Economy Following a Nuclear Attack, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 263.

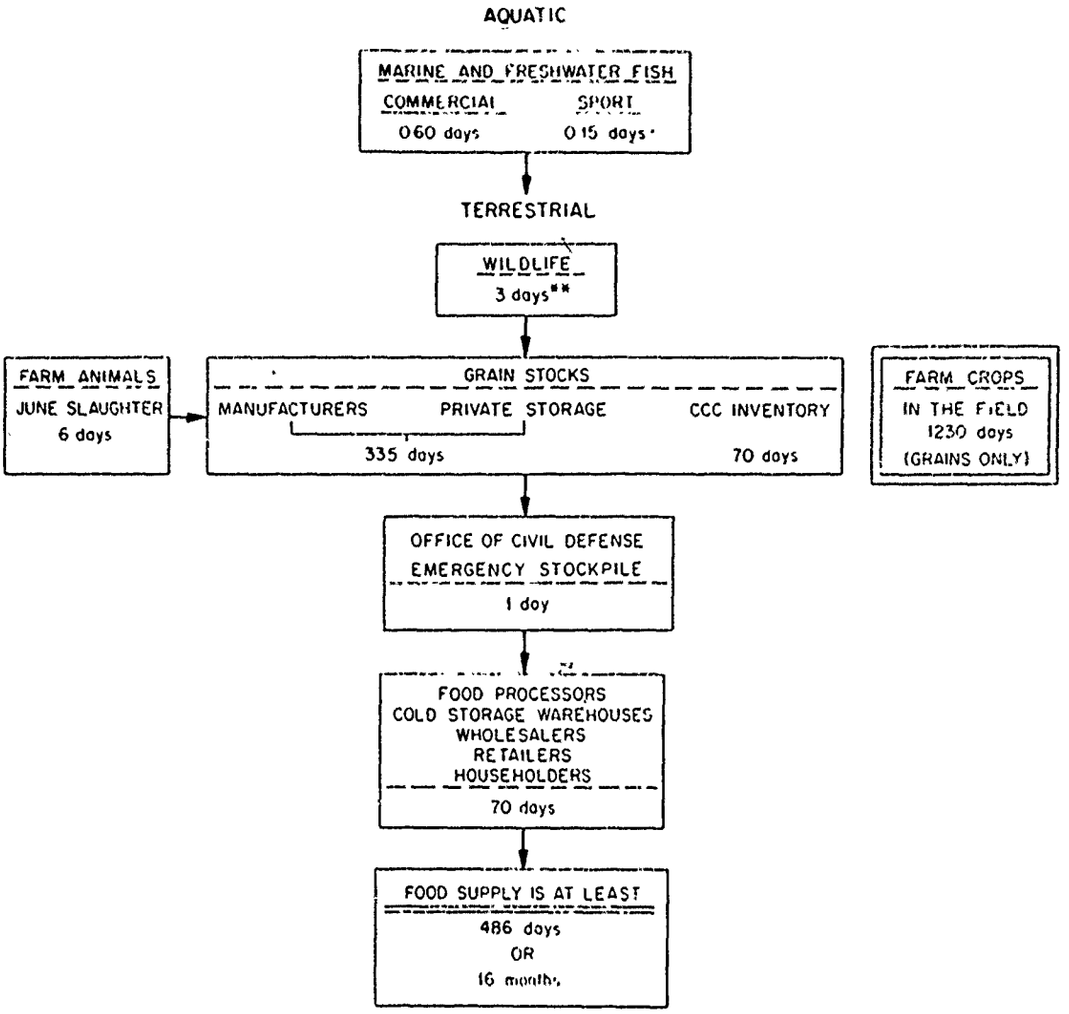

Chart 17. Estimated National Food Supply, July 1, 1967.

Source: A. F. Shinn, Food Crops and Postattack Recovery, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, p. 25.

an annual food production cycle. This chart is the basis for estimates by the Department of Agriculture to the effect that food supplies will be adequate to supply survivors, provided transportation and fuel is available.

While physical resources generally may be anticipated to be available in the postattack environment there will still remain many hazards and difficulties to be overcome to avoid major catastrophe, and to realize the full benefits from postattack capacity and assets. The postattack period from five days to 50 days, the emergency response and operation phase, warrants extensive study and far more preplanning than has been feasible heretofore. This advance planning can assure effective management of resources to overcome critical problems such as winter weather, radiation monitoring, designation of "safe" routes, disrupted communications, local shortages of food or transportation, contaminated water, and other manageable difficulties.[45/]

The absence of advance planning and resolution of the more obvious postattack management problems invites waste, chaos, and lack of control that may range from national ineffectiveness to disaster in local situations.

A persuasive analysis was presented two years ago for a dispersion and shelter program in terms of its value in facilitating effective management during the postattack survival and recovery period. A pre-attack dispersal of population plan would necessarily provide for pre-attack movement of appropriate food stockpiles to be near the dispersed population, and indoctrination in postattack water, medicine, and other priority distribution problems. An important product of the planning is the development of a civil defense and mobilization awareness, with the necessary training needed to obtain required fallout shelters during the crisis period; and this emergency pre-attack activity would not only provide ample opportunity for

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45/ Systems Analysis in Postattack Research Management, Jack C. Greene, (Postattack Research Division, OCD), December 1968, pp. 7-9.

realistic confrontation and solution of immediate problems, but also the refinement of contingency plans for survival and recovery demands in the event the attack actually occurred.46/

The studies and analyses cited endorse the evaluation that survival and recovery to desirable living standards is feasible. A program of pre-attack population dispersion from our larger cities and construction of shelters at the dispersed locations is far less of a national challenge than survival and recovery, postattack. The civil defense research report literature cited (IDA, SRI, RTI, Dikewood, Hudson) contains case study descriptions of means, and evacuation planning, as well as expedient shelter construction feasible in many cities.

Are there other means, less than detailed prototype examples, for estimating the feasibility of pre-attack reallocation of population programs? To compound the question further, can the dispersion policy be implemented while at the same time maintaining significant national production? Can the probability of blast casualties be reduced without major interruption to critical production? And without an increased risk of fatal exposures to fallout?

These questions introduce the concept of maintenance of the work force at critical places of employment. In turn, this involves different commuting patterns, greater travel times and distances, possibilities of scheduled separation from families, special shelter construction for selected personnel, and the general capabilities of buses, car pooling, commuter trains, and other features of our transportation industries to respond to the new demands.

A recent study by the Planning Research Corporation, Urban Form as a Passive Defense Variable, provides a basis for generalizing as to the extensiveness of the typical journey to work.

46/ "On Reorganizing After Nuclear Attack," William M. Brown, The Rand Corporation, from Proceedings of the Symposium on Postattack Recovery from Nuclear War held at Fort Monroe, Virginia, November 6-9, 1967, pp. 388-392. See also Arms Control and Civil Defense, Annex I--The Question of Crisis Evacuation, Jeremy J. Stone, Hudson Institute Inc., August 20, 1963.

> "The ratio of workers residing and working in a community to total employment falls almost entirely in the 25 to 75 percent range, with a typical value of about 50 percent. The ratio of total employment to resident workers for communities within existing metropolitan areas and of a size comparable to the community units of the study configuration is a minimum of 30 percent with a median of about 50 percent." 47/

It is noted further that in 1960 some 64 percent of all employed population traveled to work by private automobile, including car pool. For urban workers alone, the percentage was slightly higher. An additional 10 percent in each category (total United States; urban workers) walked to work. Most of the remainder used public transportation.48/

These statistics, fragmentary and incomplete though they may be, verify the commuting nature of much of the traffic on the various by-pass and belt line networks that have come into being as a part of our interstate and defense highway network. These roadways have essentially eliminated the use of mileage figures in local travel estimates and replaced them with time estimates. It is now common to travel 30 miles by freeway in far less time than five or ten miles on roads of less quality and high traffic signal frequency. Eighty million taxi and passenger vehicles, plus 17 million trucks and buses, one gasoline service station per 800 residents, daily petroleum flows of over one gallon per capita, bulk truck tank capacities slightly in excess of daily consumption, and about three weeks inventories are typical measures from the transportation/petroleum industry. The flexibility of these resources is almost beyond definition.

47/ Urban Form as a Passive Defense Variable, Planning Research Corporation, 16 January 1967, p. 17.

48/ Emergency Operations Systems Development Movement to Shelter, Phase I Analytical Report, Stanford Research Institute, August 1965, p. D-2, and U.S. Census of Population, 1960, U.S. Department of Commerce, Vol. I.

In addition to these automobile resources, the capacity of existing trucks and trains would permit a single loading of over 100 million tons, or about one ton for each citizen of our more densely populated urban areas. This does not suggest a relocation movement of 100 million persons. It does suggest that transportation resources are sufficiently abundant and flexible to eliminate fear of permanent and critical shortages.

The establishment and maintenance of an acceptable medical care system in a dispersed posture also appears feasible from the separate perspectives of hospital care and physician care.

There were in 1967, some 29,361,000 hospital admissions which amounts to 80,440 per day.[49/] It is generally recognized that many hospital admissions are elective, or otherwise temporarily non-critical and could be deferred. The extent to which the normal work load could be reduced under emergency condition has been estimated at 75 percent.[50/] Assuming that the "crisis" admission rate could be reduced by 75 percent, the daily national admission rate would change from 80,440 to 20,110. Since the non-critical cases would be deferred, one could expect that most if not all of these 20,110 cases would be sufficiently serious to warrant a much higher than normal degree of hospital services and medical care attention. The normal average hospital stay time of 9.2 days could not be expected to apply to these 20,000 new admissions daily.

Of the 7, 172 hospitals and 1,671,000 hospital beds in the United States, there are 2,171 hospitals of 50 beds or less for a total of 68,212 beds; and 1,734 hospitals between 50 and 100 bed capacity for a total of 121,744 beds. Generally, the hospitals with less than 50 beds are in rural and low density urban areas; those with 50 to 100 bed capacities are in urban areas of less than 50,000 population.

49/ Journal of the American Hospital Association, August 1, 1968.

50/ U.S. Civil Defense Health Services and Special Weapons Defense, AG-11-1, Federal Civil Defense Administration, December 1950.

In a dispersed population posture, hospital patient capacity could be doubled by austere management procedures. Thus, one can assume that (2 x 68,212) + (2 x 121,744) or 379,912 bed spaces would be available. In addition to this capacity, one can add the 2,500 Packaged Disaster hospitals of 200 beds each which accounts for 500,000 additional beds making a grand total available for use of 879,912.

Using the estimate of 20,000 admissions per day, and assuming the hospital stay time to last the duration of the crisis period, it would take about 44 days to saturate the capacity.

The "Packaged Disaster Hospitals" are equipped with 30 days supplies and could be activated in local schools. The majority of extra supplies allowing a doubling of the regular hospital capacity could be moved from Central City Medical Centers during the early crisis deployment period.

The other major component of medical care is physicians. The average person in the United States sees or otherwise consults a physician five times per year.[51/] The distribution of these contacts is as follows.

Office visits	66%
Home visits	10%
Clinic or hospital Visits	9%
Telephone	10%
Other	5%

The USPHS division of Emergency Health Services estimates that physician visits under emergency conditions could quite safely be reduced by 50 percent changing the five to 2.5 visits per year per person.

Of 200,000,000 people, this means 500,000,000 visits per year or about 1,370,000 visits per day. If the physician spent on the average of 20 minutes with each patient he could see 30 patients in a 10-hour work day. Thus it would require 45,666 physicians to manage the work load, with perfect distribution.

51/ National Center for Health Statistics, Personal Health Expenses, Series 10, Number 27.

Since there are currently 295,000 physicians in active practice in the United States, the medical personnel to man the hospitals and perform the physician visit services would be substantially more than adequate, on a pre-attack, emergency basis.

A point of major significance is that even if required resources are underestimated and available resources substantially overestimated, there still appears to be sufficent capability to sustain an acceptable dispersed population medical service system for a 20-30 day period.

The Home Protection Fallout Surveys provide the basis for estimating the extensiveness of basements, and the further classification of basements by protection factor. These estimates are presented in Table 11, "Estimated 1975 Distribution of Homes Without Basements, and Homes With Basements With PF Factors Under 10 to Over 40." This resource is unexpectedly extensive. If one adds to it the concept of crowding, or loading factors, plus NFSS spaces, and the additional shelter that can be constructed during the crisis period, or modifications to existing buildings, the attractiveness of a dispersal and shelter policy becomes more and more appealing. Shortages of basements in the South and Southwest, Regions 3 and 7, present special requirements for extensive expedient fallout shelter programs.

All available measures of necessary resources, together with relevant case study planning, show a dispersal and shelter posture to be feasible and desirable. The risk that is associated with <u>not</u> developing detailed urban relocation plans will be examined in the following chapter.

Table 11

Estimated 1975 Distribution of Homes
Without Basements, and Homes With
Basements With PF Factors Under 10 to Over 40

STATE	TOTAL HOMES	HOMES W/O BASEMENTS, PF 2	HOMES WITH BASEMENT			
			UNDER 10 PF	PF 10-19	PF 20-39	PF 40+
U.S. TOTALS	100.0	53.2	0.4	7.5	35.5	3.4
REGION 1	100.0	20.2	0.5	14.0	57.8	7.5
CONNECTICUT	100.0	22.5	0.4	16.3	55.9	4.9
MAINE	100.0	31.4	0.4	13.5	47.8	6.9
MASSACHUSETTS	100.0	18.9	0.4	15.3	59.0	6.4
NEW HAMPSHIRE	100.0	19.7	0.0	9.2	65.9	5.2
NEW JERSEY	100.0	24.7	0.5	13.4	53.9	7.5
NEW YORK	100.0	17.7	0.5	13.7	59.8	8.3
RHODE ISLAND	100.0	22.2	0.4	20.3	46.6	10.5
VERMONT	100.0	16.1	0.0	2.4	76.7	4.8
REGION 2	100.0	35.4	0.9	12.2	45.6	5.9
DELAWARE	100.0	46.1	0.6	10.9	33.4	9.0
DISTRICT OF COLUMBIA	100.0	39.5	1.3	27.4	21.0	10.8
KENTUCKY	100.0	67.1	1.1	7.4	22.5	1.9
MARYLAND	100.0	35.0	0.7	18.1	37.6	8.6
OHIO	100.0	28.8	0.8	11.6	52.9	5.9
PENNSYLVANIA	100.0	17.1	0.8	12.5	61.8	7.8
VIRGINIA	100.0	65.0	0.7	10.4	21.9	2.0
WEST VIRGINIA	100.0	56.7	1.9	10.2	29.1	2.1
REGION 3	100.0	89.1	0.4	2.4	7.7	0.4
ALABAMA	100.0	90.7	0.4	2.0	6.6	0.3
FLORIDA	100.0	98.6	0.0	0.4	1.0	0.0
GEORGIA	100.0	86.5	0.4	3.2	9.5	0.4
MISSISSIPPI	100.0	97.3	0.0	0.6	1.9	0.2
NORTH CAROLINA	100.0	81.4	0.6	4.1	13.2	0.7
SOUTH CAROLINA	100.0	92.6	0.3	1.7	5.1	0.3
TENNESSEE	100.0	77.1	0.8	5.1	16.2	0.8
REGION 4	100.0	29.5	0.3	7.3	58.6	4.3
ILLINOIS	100.0	28.0	0.4	8.3	59.0	4.3
INDIANA	100.0	44.8	0.3	6.5	45.1	3.3
MICHIGAN	100.0	31.5	0.3	7.9	55.9	4.4
MINNESOTA	100.0	22.3	0.1	7.4	66.2	4.0
WISCONSIN	100.0	17.4	0.3	4.3	72.4	5.6

Source: System Sciences, Inc., DAL-69 Study, Phase-I Work Plan, Sensitivity Analysis, 1969, p. 125.

Table 11 (Continued)

Estimated 1975 Distribution of Homes

Without Basements, and Homes With

Basements With PF Factors Under 10 to Over 40

STATE	TOTAL HOMES	HOMES W/O BASEMENTS, PF 2	HOMES WITH BASEMENT			
			UNDER 10 PF	PF 10-19	PF 20-39	PF 40+
REGION 5	100.0	96.2	0.1	0.8	2.8	0.1
ARKANSAS	100.0	95.2	0.2	1.0	3.4	0.2
LOUISIANA	100.0	98.1	0.0	0.4	1.4	0.1
NEW MEXICO	100.0	92.1	0.0	1.8	5.7	0.4
OKLAHOMA	100.0	90.0	0.2	2.2	7.4	0.2
TEXAS	100.0	97.6	0.1	0.5	1.7	0.1
REGION 6	100.0	39.4	0.3	7.4	50.5	2.4
COLORADO	100.0	50.5	0.1	7.4	39.7	2.3
IOWA	100.0	22.0	0.2	7.3	67.0	3.5
KANSAS	100.0	52.8	0.1	6.2	38.6	2.3
MISSOURI	100.0	43.2	0.4	9.5	45.1	1.8
NEBRASKA	100.0	28.7	0.7	7.9	60.4	2.3
NORTH DAKOTA	100.0	22.7	0.0	3.3	70.7	3.3
SOUTH DAKOTA	100.0	28.8	0.0	2.6	65.5	3.1
WYOMING	100.0	51.6	0.0	2.1	45.2	1.1
REGION 7	100.0	83.4	0.1	3.6	12.5	0.4
ARIZONA	100.0	97.6	0.0	0.9	2.2	0.2
CALIFORNIA	100.0	83.9	0.2	3.6	12.0	0.3
HAWAII	100.0	91.0	0.0	2.1	6.4	0.5
NEVADA	100.0	85.0	0.0	3.9	10.5	0.6
UTAH	100.0	42.2	0.0	9.9	46.6	1.3
REGION 8	100.0	59.5	0.4	6.8	32.0	1.3
ALASKA	100.0	72.2	0.0	13.9	12.5	1.4
IDAHO	100.0	52.9	0.5	2.8	42.9	0.9
MONTANA	100.0	45.4	0.0	3.7	49.5	1.4
OREGON	100.0	67.7	0.4	7.0	23.8	1.1
WASHINGTON	100.0	57.5	0.4	7.7	32.9	1.5

NOTE: Homes of non-respondents to the HFPS in each state were assigned one-half PF 3 and one-half PF 10-19, in this table. These homes totalled 5.3 million in 1975.

Source: System Sciences, Inc., DAL-69 Study, Phase-I Work Plan, Sensitivity Analysis, 1969, p. 126.

Chapter 4

Casualty Estimates
Under
Outward Movement and Shelter Concepts

The purpose of this chapter is to present estimates of casualty reductions believed attainable through one or more movement strategies. Conceptually, the urban population, or fractions thereof, would move outside the central cities, and more preferably outside the Standard Metropolitan Statistical Areas in most cases, during an indeterminate period of international tension, and in contemplation of direct massive attack on the United States. The time of attack is uncertain. Overt hostilities have not been initiated. The program emphasizes extensive use of rural and suburban homes; dormitory-type improvisations; expedient fallout shelter construction and augmentation; and commuting to priority jobs. Essential production is maintained, and inventories of critical goods increased. The move period may last days, or weeks, and will be terminated by the attack, or acceptable resolution of the tension and crisis causes.

It will be recalled that in Chapter 2, certain findings and recommendations of Stanford Research Institute were presented. Among these were "Effects of Dispersal" from a metropolitan center. The key figures, assuming all residents to be in reinforced home basements, and with a PF of 36, were as follows:

Effects of Dispersal on Metropolitan Population

Outward Shift of Population	Percent Fatalities		Percent Survivors
	Blast	Fallout	
0 miles	27	17	37
8	5	20	65
14	3	15	80

These figures measure the blast hazard to populations in metropolitan areas. As blast casualties are reduced, survivors increase, although not necessarily in direct correlation.

Many millions live near urban centers, and comprehensive dispersal movement analyses should include continuing exposure to fallout and blast effects. For many reasons beyond the scope of the present analysis, few ground zeros can be expected to occur at aiming points assumed or calculated by U.S. strategists. No known strategy will eliminate fatalities. Fatalities may be reduced by movement, but for all realistic analysis purposes there are no areas perfectly "safe" from nuclear attack.

Few analyses have addressed themselves exclusively to trade-offs involving urban relocation alternatives and fallout shelter survey and augmentation programs at modest civil defense financial levels. Total civil defense appropriations of $100 million, annually, or less than fifty cents per person is regarded herein as a modest program. One relevant set of calculations is the one by the Hudson Institute, made in 1964, when the CSP program was at an early stage, and prior to significant availability of NFSS data.

Selected calculations for four different attacks on the United States, assumed to occur in 1970, have been extracted from the Hudson Institute study, and are presented in Table 12, "Results of War Game Calculations for Alternative Civil Defense Postures." Six different civil defense programs are assumed. They range from the extreme of "No Protection Program" to "100% Urban Blast Shelters."

Each attack shows significant decreases in blast mortalities possible by evacuation, whether 50 percent evacuation or 80 percent evacuation. The lightest attack (1970 War # III) shows blast mortalities decreasing from 51 million, as a no evacuation case, to 26 million at 50 percent evacuation, and at 80 percent evacuation reduced further

Table 12

RESULTS OF WAR GAME CALCULATIONS FOR ALTERNATIVE CIVIL DEFENSE POSTURES

Program	Protection Factors	1970 War #III: 258 MT Airburst Counterforce, 225 MT Airburst Countervalue, 750 MT Groundburst Countervalue — Mortalities (Millions) Blast	F/O	Total	Surv.	1970 War #IV: 200 MT Airburst Counterforce, 12,800 MT Groundburst Counterforce, 3,050 MT Groundburst Countervalue — Mortalities (Millions) Blast	F/O	Total	Surv.	1970 War: 45 Bombers & 140 Warheads, 1,792 MT Groundburst — Mortalities (Millions) Blast	F/O	Total	Surv.	1970 War: U.S.S.R. Countervalue 1st Strike, 14,208 MT Groundburst — Mortalities (Millions) Blast	F/O	Total	Surv.
I. No Protection Program	2.5	51	28	79	115	83	80	163	31	38	56	95	99	80	110	190	4
II. Gov't Survey																	
	URB: 25% PF 100	51	12	63	131	83	55	138	56	38	23	61	133	80	61	141	53
	25% PF 40																
	25% PF 20																
	25% PF 2.5																
	RUR: 20% PF 40																
	40% PF 20																
	40% PF 2.5																
III. Complete Fallout																	
	50% PF 100	51	0	51	143	83	5	88	106	38	.1	38.1	156	80	15	96	98
	50% PF 500																
IV. 50% Evac.																	
	URB: 50% PF 100	26	2	28	166	41	20	61	133	19	7	26	168	40	67	107	87
	50% PF 40																
	RUR: 50% PF 100																
	50% PF 20																
V. 80% Evac.																	
	URB:100% PF 500	10	1	11	183	17	15	32	162	8	4	12	182	16	45	62	132
	RUR: 25% PF 500																
	50% PF 100																
	25% PF 20																
VI. 100% Urban Blast Shelters																	
A. 10-100 PSI	100% PF 500	7	0	7	187	22	1	23	171	9	0	9	185	49	9	58	136
B. 10-500 PSI	100% PF 500	1.8	0	1.8	192	5.5	1.5	7	187	2	0	2	192	13	11	24	170

Source: Hudson Institute, Alternative Civil Defense Programs and Postures, June 11, 1964, pp. 17, 19, 23, 29.

to 10 million blast fatalities. A much heavier attack (1970 War # IV) consists of approximately 16,000 megatons with mixed counterforce and countervalue objectives. The pattern of reduced blast fatalities by evacuation is the same; 83 million blast fatalities without evacuation; reduced to 41 million by 50 percent urban evacuation; and reduced further to 17 million blast fatalities at 80 percent evacuation.

The only program that is superior to evacuation, in increasing numbers of survivors, as calculated in Table 12, is that of 100 percent urban blast shelters, plus PF 500 for all non-urban population. In gross terms, an urban population dispersal posture can be "guesstimated" at costing about 10 percent of the dollars and far less time than that required for an urban blast shelter program. A dispersal program of $300 million conceptually is equated with an urban blast shelter program of $3 billion. Except for concept illustration, these estimates have little utility, as any "balanced" gross dollar program should include significant investments for fallout protection, particularly in the rural areas.

The four attacks, and the six alternative program assumptions, illustrate the continuing risk to population from combinations of blast and fallout, regardless of the countermeasure. For example, in all four attacks evacuation is superior in saving lives to a "Complete Fallout" program under which the entire population has at least a PF of 100; yet within this total savings of lives there are important localized increases in deaths caused by fallout only. In the 1970 War # IV, for example, blast fatalities are reduced from 83 million to 41 million by a 50 percent evacuation program; yet fatalities caused by fallout increase from 5 million to 20 million as a consequence of evacuation from urban fallout shelter to less protective fallout shelter in rural areas. However, the 50 percent evacuation program reduces total fatalities from 88 million to 63 million, a substantial savings.

Complete avoidance of blast effects on the one hand, and fallout effects on the other, is not feasible for almost all of the population. For those who live within larger urban areas, there are substantial risks from blast effects and hazards that no foreseeable program can eliminate entirely. Expected total survivors can, however, be increased significantly by combinations of blast avoidance and fallout shelter.

The detail presented in the four sets of calculations in Table 12 demonstrate again the validity of full fallout shelter as a reliable lifesaving program, particularly if fallout shelter is provided to rural populations. Urban fallout shelter is shown, in Table 12, to be of lesser importance, as urban populations suffer high blast fatalities.

Suggested within the national summary statistics presented in Hudson Institute's calculations are the real complexities of civil defense program alternatives. Basically, the different parts of the United States are not at equal risk. Further, different city and rural areas have varying amounts of fallout or other shelter inherently available through coincidence or unpredictable happenstance. Chance and probabilities are such that the smaller the geographical area of concern, the greater the fluctuation in actual attack effects from one "war game" to another. This point is evident from almost any two attack analyses.

Table 13, "Percent Blast and Thermal Housing Damage for SMSA and Remaining Areas by OCD Regions, UNCLEX and OPAL 61 Attacks," utilizes data on blast damage on dwelling units[52/] to help make this point. The UNCLEX attack was much more severe, causing about 40 percent more total damage. Both attacks were heavily SMSA-oriented. Nevertheless, in Region 5, SMSA housing damage was substantially less in the heavier attack. For Region 7, the heavier attack caused almost six times greater damage to SMSA housing, but slightly less damage to the non-SMSA housing in the same region.

The same phenomena are observed by a review of the housing damage at the SMSA level. The heavier attack that caused, nationwide, about 40 percent more housing destruction, caused less damage to the following SMSA's--Portland (Maine), Pittsfield, Allentown, Evansville, Canton, Altoona, Lancaster, Roanoke, Mobile, Atlanta, Savannah, Durham, Greensboro, Raleigh, Winston-Salem, Chattanooga, Knoxville, Evansville, Grand Rapids, Duluth, Ft. Smith, Oklahoma City, Amarillo, Corpus Christi, Dubuque, and Topeka. Conversely, greater damage was caused to the housing in some SMSA's by the lighter attack. Appendix A lists the damage, by SMSA, for these two attacks.

52/ Housing estimates are frequently preferable to casualties as the unit of measure when comparisons are made between attacks. There are great differences between the various casualty models, and even greater differences in final casualty estimates can be caused by warning time assumptions, or changing estimates of protection data such as that being derived constantly from NFSS, HFPS, and CSP programs.

Table 13

Percent Blast and Thermal Housing Damage for SMSA and Remaining Areas by OCD Regions, UNCLEX and OPAL 61 Attacks

Region	Percent of Damaged SMSA Housing		Percent of Damaged Non-SMSA Housing		Percent of Total Housing Damaged	
	OPAL 61	UNCLEX	OPAL 61	UNCLEX	OPAL 61	UNCLEX
1	67.3	94.5	36.6	30.9	60.4	80.1
2	76.7	92.0	3.0	18.5	52.3	67.4
3	62.6	68.6	11.5	7.5	31.2	34.8
4	65.7	90.3	4.3	13.7	42.0	61.6
5	84.9	72.8	11.4	6.9	43.9	42.0
6	72.0	82.5	7.0	7.3	33.0	40.0
7	15.2	88.8	17.4	14.3	15.6	77.3
8	54.4	83.2	16.3	8.6	31.5	43.4
Total U.S.	62.2	87.2	11.7	13.4	42.3	60.2

SOURCE: S.S.I. This table is a summary of Appendix A at back of this document.

These details from the OPAL 61 attack, and the UNCLEX attack are presented to emphasize the complexities involved in designation of the SMSA's at greatest hazard to blast effects, or more particularly the portions of the SMSA's most likely to receive significant blast effects. Judgment is inevitably involved, for the imponderables are almost limitless.

An attempt was made to reduce the imponderables to fundamentals, using the method of parametric analysis for countervalue attacks, the National Civil Defense Computer Facility, and some of the computations performed for other civil defense analysis purposes.

To direct analysis to the essentials of civil defense planning and preparedness actions that appear to have the greatest payoff in lives saved, the following assumptions, believed realistic, were made:

a) No ABM or similar active defenses, in-being, to protect urban population for the foreseeable future;

b) No shelter construction program, whether dual-use blast, or special blast, or special fallout is foreseeable; and

c) Total federal civil defense expenditures will probably be less than those necessary to maintain current (January 1970) capability; that is, less than $100 million per year.

In designing the analysis, the country was divided into two parts, urban and rural. All urban areas in the United States were divided into one of the following four overlapping classes:

10	Most heavily populated urban areas
30	" " " " "
100	" " " " "
All	Urban areas greater than 25,000 population

For the rural areas, five different shelter postures are assumed. For the urban area analyses, 15 different shelter cases are assumed. Thus, there were 60 urban shelter cases; and for each of these 60 urban shelter combinations, five different rural shelter postures, or a total of 300 combinations.

Further, for each of these 300 combinations, four different degrees of evacuation were assumed: 0% evacuation, 25% evacuation, 50% evacuation, and 75% evacuation. There are some 1,200 combinations, or sets of curves derivable from the calculations.[53/]

The attack objective was countervalue, and consisted of 1 MT weapons, 75 percent reliable, with 3,000 ft. CEP. Separate subtotals of effects were tabulated at approximately the 30th weapon; the 300th weapon; and the 3,000th weapon. A separate record was kept of primary fatality cause; blast, or fallout.

53/ Three sets of the voluminous calculations, "Applications of DASH for Shelter Program Analysis," 14 November 1969, including many of the curves, have been bound and delivered to Office of Civil Defense, including one to the contract monitor. A file copy, with work sheets, is available for inspection at main offices of System Sciences, Inc.

Table 14, "Percent Total Fatalities from 3000 One MT Weapons For Varying Degrees of Shelter and Levels of Evacuation," attempts to illustrate the most sensitive results. The left half of Table 14 estimates the type of urban shelter available today--half the urban population in NFSS spaces above-ground, and the other half in residences--with the rural standard location areas having two different protection facts: 2 PF and 20 PF. Without evacuation, and with a rural 2 PF, some 80 percent of the total population become fatalities. With 75 percent evacuation, fatalities are reduced to about 60 percent of pre-attack population.

The identical attack, assuming a rural 20 PF, has far less fatalities. With no evacuation, casualties are about 70 percent; with 75 percent evacuation, casualties are reduced to about 20 percent of pre-attack population.

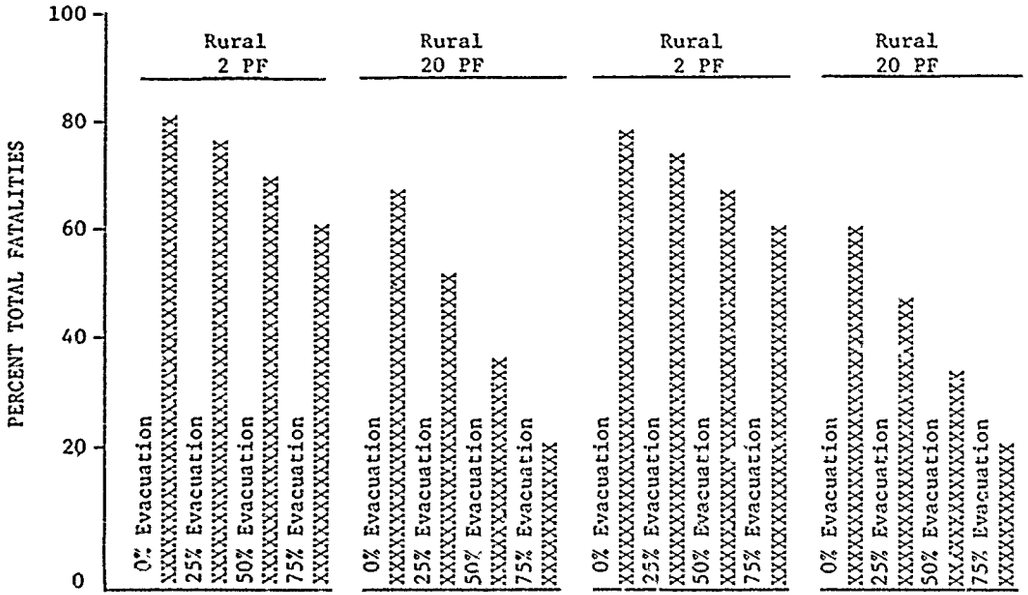
Directing attention now to the right half of Table 14, the same attack is assumed against half the urban population in below-ground NFSS spaces, with the balance in home basements. The better urban blast protection results in only about 3 percent savings in casualties, an amount not distinguishable on the vertical scale of Table 14. The rural 2 PF cases are almost identical, with both showing substantial savings in fatalities by evacuations.

Similarly, the two sets of rural 20 PF bars comparing evacuation and urban shelter are almost identical, except that in a 0 percent evacuation there are less fatalities.

Table 14

Percent Total Fatalities from 3000 One MT Weapons*
For Varying Degrees of Shelter and Levels of Evacuation

Urban Shelter (50% at 7 PSI**40 PF) (50% at 4 PSI 2 PF) Above-Ground Shelters and Homes		Urban Shelter (50% at 12 PSI 350 PF) (50% at 4 PSI 30 PF) Below-Ground Shelters and Home Basements	
Rural 2 PF	Rural 20 PF	Rural 2 PF	Rural 20 PF



* Note: Curves for each vertical bar above, 30 weapons to 3000 weapons, showing (a) total fatalities and (b) blast fatalities only, are contained in Appendix

** Median lethal overpressure, that blast overpressure at which 50 percent of the occupants may be expected to be fatally injured.

SOURCE: S. S.I. See Appendix B pages 2-3.

The vertical bars shown in this table suggest three conclusions:

a) Evacuation can save large numbers of lives.

b) Rural fallout shelter, even at low levels, such as 20 PF, is highly effective.

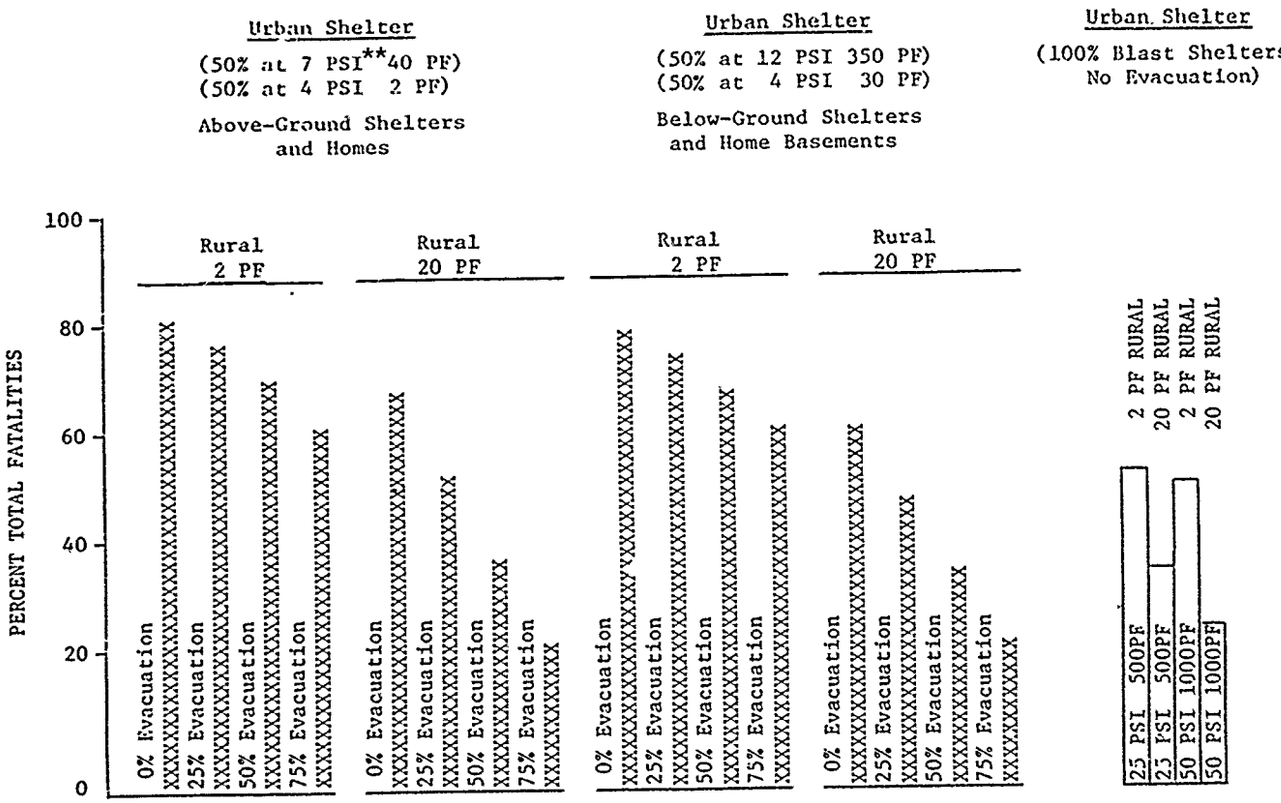
c) Urban blast protection programs at 12 psi, for half the population, may not be significant unless extended to the entire urban population.

These three conclusions are reinforced by an examination of Table 14a, which is identical with the preceding table, except that it adds two urban blast shelter cases (25 PSI and 50 PSI) and two rural PF cases, 2 PF and 20 PF. To focus on fundamental aspects, and avoid complexities, estimated fatalities assuming different degrees of evacuation are not presented in this table. Evacuation appears inconsistent as a strategy, when coupled with a special blast shelter construction program. The curves depicting lives saved from evacuation are reproduced in Appendix B.

The numbers of lives saved from a special blast shelter construction program that would accommodate all urban residents are of the same order of magnitude as a 50 percent evacuation program or a 75 percent urban evacuation program. Planning and obtaining an evacuation posture appears feasible and meaningful under present and foreseeable levels of civil defense funding. When combined with rural fallout shelter survey and expedient fallout shelter development programs, a comprehensive movement to shelter program may be the only significant lifesaving response open to civil defense authorities vested with responsibilities at the national level.

Table 14a

Percent Total Fatalities from 3000 One MT Weapons*
For Varying Degrees of Shelter and Levels of Evacuation



* Note: Curves for each vertical bar above, 30 weapons to 3000 weapons, showing (a) total fatalities and (b) blast fatalities only, are contained in Appendix

** Median lethal overpressure, that blast overpressure at which 50 percent of the occupants may be expected to be fatally injured.

Source: S.S.I. See Appendix B, pages 2, 3, 5, 6, 7.

Chapter 5

Methodologies for Planning Dispersal and Shelter Postures

The perpetual quandary in civil defense planning has been uncertainty as to target objectives of the enemy. The question has vexed the American public and civil defense planners for at least the last 20 years. The assumed target objectives change over time, for many reasons. Yesterday's enemy may be today's friend. Continuing change can be anticipated, with inevitable time lags necessary for a defense to respond efficiently to an innovation from the offense.

Change in target objectives may also be introduced by the defense. The fallout shelter program that had obvious merits in the early 1960's when coupled with active defenses would present a possible enemy with different options when active defenses are no longer authorized.

A key principle in any military or civilian operational methodology is "keep it simple." Simplistic methodologies in the field of civil defense (blast shelters or fallout shelters for all) may be formulated only at excessive cost or risk to large numbers of the population. Simplicity, low-cost, and efficiency make for incompatability in a civil defense context.

Relatively simple methodologies, for example, have been developed to assess the national impact of blast, thermal, fallout, and other effects, and trade-offs with protective measures, whether fallout shelter, blast shelter, or evacuation. The Office of Civil Defense, its predecessor agencies, and associated offices within the Government have performed many assessments and measures of the threat and enemy capabilities to inflict damage on the United States. The final tallies of those nation-wide war games and damage assessments tend to be generally consistent with one another. This generalization includes allowances for differences with regard to target objectives, shelter availability estimates, assumptions as to warning time and the degree of reaction and knowledgeable response to the warning by the population. Enemy stockpiles and military capabilities versus our own defense are also included.

National planning, however, is not necessarily helpful for local planners concerned with local effects. It is different in concept from the analyses and evaluation of individual members of the population who are concerned primarily with the welfare of their families and themselves. The translation of national generalizations into local specifics defies simplicity and ease. A comparison of the destruction for almost any two attacks will serve to make the point. For example, Appendix A, "Comparison of Housing Unit Damage in Selected SMSA's from the OPAL '61 Attack and the UNCLEX '66 Attack," lists the housing units sustaining blast and/or thermal damage for each of the Standard Metropolitan Statistical Areas in two different attacks. Blast and/or thermal damage to dwelling units was chosen in preference to casualties in order to eliminate significant influences on casualty estimates from assumptions as to shelter availability, warning time, response reactions, prevailing weather, and so forth. The UNCLEX attack was the far heavier attack with some 60 percent of the dwelling units in the United States suffering from blast and thermal damage. The OPAL 1961 attack had a comparable national damage of dwelling units of 42 percent. Despite its being a smaller attack, in 20 of the SMSA's OPAL '61 estimates showed at least 50 percentage points more damage than the far heavier attack of UNCLEX. Localized variations of 50 percent and greater magnitudes are commonly manifested between different attacks, including those with identical objectives.

An equally great variation is introduced by the uncertainty with regard to the distribution of fallout. Although one can say quite accurately that in general winds move from west to east, this does not provide a sound basis for operational estimation of deposition of fallout. At any one particular time the differing altitudes of wind direction may vary as much as 180 degrees from the prevailing winds. But from what ground zero, or ground zeros, does one assume the fallout originates?

Analysis of attack effects, particularly at the local levels, leads quickly to the conclusion that there are few "safe" places in the United States. On the other hand, some areas are more dangerous than others. There are considerable intelligence and other resources to assist localities to understand their degree of hazard. With such help, it is

feasible to distinguish between the relatively safe and the relatively dangerous areas, but even that distinction has within it extremely high inputs of qualitative judgment.

Fortunately, valid analytical concepts, together with complementary computer facilities, are at hand with which to assist in contending with this dilemma. Many staff members of the Office of Civil Defense have assisted in the pioneering work necessary to develop the probability estimating procedures derivable from Nuclear Attack Hazard in Continental United States-1963 (NAHICUS-63),[54/] prepared by the Department of Defense and Office of Emergency Planning. The National Civil Defense Computation Facility through use of DASH has proficiency in running detailed attack analyses and in recording the attack effects for shelter and/or movement guidance. If necessary, the guidance sub-totals could be accumulated at standard location levels. Use of these concepts enables one to bridge the gap between general national models and highly localized effects.

Study of the evaluations derived from NAHICUS and DASH suggests that it is feasible to distribute the population in such a way as to use distance as protection from blast and thermal effects, and thus reduce casualties. Further, this same analytical procedure can be utilized as a means of evaluating the cost and benefits, of such evacuation and shelter, as distinct from the present community shelter planning (CSP) strategy. The preceding chapter, and Appendix B, presents examples of some of the kinds of comparisons described more fully in "Applications of DASH for Shelter Program Analysis."

Efforts are currently being made to update the NAHICUS-63 calculations, and incorporating the National Fallout Shelter Survey findings. However, these updated calculations will not include the population and shelter allocations under Community Shelter Planning. There is no known routine for

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54/ See particularly Annex A, Background and Procedures for Applications, "Nuclear Attack Hazard in Continental United States-1963," Department of Defense and Office of Emergency Planning, March 1964, mimeographed, 76 pp., Unclassified; NAHICUS Map Supplements of Summary of Attack Effect Probabilities (Secret); NAHICUS Population Status Summary Probabilities (Secret); and "Resource Data Catalog (Revision)," October 1968, NRAC Technical Report No. 69, Office of Emergency Planning, National Resource Analysis Center, formats F, G, and H, pp. A-10 to A-12.

translating or transferring the shelter assignments, by standard location, from CSP maps, or other final tabulation, to the tape files of the National Civil Defense Computation Facility. Until the CSP data is routinely incorporated into NCDCF it will obviously be difficult to do anything more refined than gross calculations about the benefits or disadvantages of specific CSP plans.[55/]

It is also clear that decreasing the population vulnerability in one part of the country may make another part of the country more attractive to enemy targeting, assuming that an enemy objective continues to be the destruction of population. Defensive moves can be expected to be acknowledged by some change in offensive strategy or tactics. Dispersal from one or more of our major cities cannot be expected to be concealed from a modern enemy. The enemy may, or may not, change his target objectives and associated ground zeros. One defensive objective that appears feasible because of the availability of NFSS and HFPS space is to develop plans to so reallocate our population that an approximately equal density and equal risk per square mile is achieved.

Trade-off analyses are therefore continually required. The factors to be evaluated include (a) aggregations of population so as to reduce their specific attractiveness as population targets versus (b) travel distance, travel time, labor productivity, political acceptability, and probable discomforts associated with expedient shelter, housing, and other resources that make population dispersal credible and feasible. It would be futile to specify and to expect a high degree of trade-off precision. Precision and accuracy should nevertheless be attempted with possible dispersion and shelter plans, especially if formulated by a computer for initial feasibility.

At best, in the event of large-scale attack, many millions of people cannot help but avoid being within significant blast areas. The calculation is quite simple. Moderate damage for a 5 megaton weapon

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55/ CSP's for over 100 million people are estimated to be in process as of early 1970; but CSP's have been completed for less than an estimated 25 million.

covers an area of about 400 square miles. Considering that the overall average density of population in the USA is 100 persons per square mile (discounting one-third of the Nation's area covering the almost uninhabited Rocky Mountains and desert areas of the West) a single 5-megaton weapon dropped at random would cause significant casualties due to blast effects among 40,000 people. One can well imagine the casualties due to the same effects in cities and metropolitan areas of much higher population density. This is probably why the USSR civil defense is placing so much importance on evacuation. Leon Goure in the Rand Corporation report of November 1969, entitled Soviet Civil Defense Revisited, 1966-1969, quotes a highly placed official in Soviet civil defense: ". . . One of the principal and most effective methods of protecting the population against weapons of mass destruction is the dispersal and evacuation of the inhabitants of cities to a safe distance from them. . ." Also, in the Christian Science Monitor of February 19, 1969, in an article entitled Soviet Launch Drive for Civil Defense: ". . .It is noted that the USSR considers evacuation and dispersal as important tactics of an overall civil defense strategy. . ."

It is beyond the scope of this study to explore foreign political implication of "mass" evacuation, especially Soviet, but as was shown in Chapter 4, without evacuation of cities, casualties can be many times higher. In the context of a "Crisis" 56/ situation the key questions are the choice of cities and their reception areas, the resources available in these areas, the percentage of the population evacuated while at the same time maintaining productivity of critical industries, the guidance to be provided to the States and localities on planning and the coordination with the national response to the crisis.

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56 The evacuation system herein contemplated might or might not be "triggered" by the President in response to a Soviet evacuation. Besides reducing casualty probabilities, it can be regarded as a means for maintaining urban populations in a dispersed posture during a crisis, or as a means of providing for the physical and psychological well-being of the survivors after an attack. See also Chapter 2, above, and the Hudson Institute studies referenced therein.

A methodology for obtaining a movement to shelter posture at national and local levels, utilizing dispersion and expedient shelter tactics, and building on existing capabilities is as follows:

1) Prepare information directives, including limited distribution to Office of Emergency Preparedness and Federal agencies with delegated civil defense responsibilities.[57/] The directives would include background of the program, invite suggestions, and alert delegate agencies to possible requests for assistance in their respective competencies.

2) Utilizing accepted intelligence and associated targeting assumptions, and applying experience developed in earlier probability studies such as NAHICUS, design a sufficient number of computer runs to include the spectrum of target assumptions and/or objectives.

57/ For an extensive listing and analysis, see Federal Organization and Responsibilities for Emergency Preparedness and Resource Management, Catalog of Federal Responsibilities by Organization Units, Section II; and Catalog of Federal Responsibilities by Resource Areas, Section III; Lynchburg College Research Center, Contract OCD-PS-66-76.

One of the more critical and complex, but low cost requirements is for an interim priority system. As an expedient, it would not initially involve ration currency and formalized controls. Time constraints require simplicity. The system should be consistent with OEP's mobilization plan "which includes a range of emergency resource management measures that could be taken within the framework of an economy undamaged by direct attack." Fulfillment of OCD's life-preserving mission, by dispersal tactics, may thus require modification of OEP's rationing plans which have "been carried on exclusively within the framework of postattack nuclear planning." These plans have substantial application to a pre-attack crisis. Further, the progress made on the objective of resource management through the States can be of great value to resource control during a "crisis" dispersal. The fact that OCD is in the process (as of January 1970) of preparing eight local emergency resource plans, within OEP guidelines, represents a fleeting OCD opportunity to include "crisis" dispersal provisions in those eight plans, which are to be prototypes. (See, Eighteenth Annual Report of the Activities of the Joint Committee on Defense Production, Congress of the United States, 91st Cong., 1st sess., House Report No. 91-3, January 8, 1969. Washington, D.C.: U.S. Government Printing Office, 1969, pp. 133-136, "Federal Resource Management Plans."

3) Obtain, by computer program, for each attack, tabulations of overpressure and fallout effects for a sample of standard locations sufficiently precise so as to enable the construction of iso-intensity overpressure and fallout contours at urban areas of greatest hazard, for each strategic targeting objective. (The sample developed for NAHICUS may be used directly, and as a basis for expansion to develop finer detail at metropolitan area levels of analysis. Alternatively, for clerical or computational convenience the attack effects may be calculated at grid intersections, such as that of a 5,000 meter or 10,000 meter grid.)

4) By computer, or "hand," extract overpressure and fallout effects for a range of "light" through "heavy" attacks, for selected targeting assumptions, for the metropolitan areas identified by samples of standard locations, or grid intersections.

5) By computer, or "hand," using a map of appropriate scale, and using the tabulations of Steps 2, 3, and 4, prepare iso-intensity contours for each metropolitan area affected by "light" attacks and by "heavy" attacks, with interpolation as necessary of discrete levels of overpressure (such as 1 PSI, 3 PSI, and 10 PSI).

   Note: Standard U.S. maps are available for the country, with UTM grids, at scales of 1:2,500,000; 1:500,000; 1:250,000; and for many cities, 1:24,000. Computer mapping routines at these approximate scales are also available.

6) By computer, or "hand," estimate the residential population within each of these alternative contours. (For any single metro area, this is a simple clerical chore; but for national analyses, the population can be aggregated and up-dated by computer.)

7) By computer, or "hand," compare the residential population inside the contour(s) with the population five miles distant from the contour line, ten miles distant, and so forth. The result of these comparisons are "crowding ratios" necessary

to accomodate the population within a contour of interest. (For allocation between "contested" areas such as Washington-Baltimore, DASH computer routines, such as SAM [Shelter Allocation Model] or those of IDA and Dikewood may be used with modifications.)

8) As "first cuts," select one or more crowding ratios believed feasible, and allocate, by computer, parametric evacuation ratios (25%, 50%, 75%, 100%) to standard locations within the selected distance corresponding to the crowding ratio. For interim analysis and planning phase purposes, the hypothetical dispersion area can be extended until interference from similar distance moves from one or more adjacent SMSA's is encountered. (An existing DASH computer routine can be utilized to allocate "contested" areas, or to formulate tentative combinations of SMSA's into dispersal planning authorities for conceptual planning.)

9) Estimate gross expedient fallout shelter requirements, after allowing for NFSS and HFPS resources within each standard location, for selected "crowding" ratios, and alternative degrees of evacuation.

10) Check calculations of expected casualty savings by selected computer "attacks" on the United States, per Step 2, and assuming that expedient fallout shelter requirements estimated in Step 9 can be met.

11) Select one or more dispersed population objectives from above steps; prepare supporting documentation and coordinate with Federal agencies.

12) Concurrent with the above, review existing postattack requirements studies on transportation, medical supply production, survival items production, petroleum, and other industries; and extend the studies to include production needed to support a dispersing population. Classify the production requirements by industries by SIC codes.

13) Using a modification of the DASH computer program, determine the production capacity, value added, and the labor force associated therewith, for the essential industries identified in the previous steps, within alternative overpressure contours.

14) Estimate, statistically, for each urban area affected in accordance with Steps 11-13, the labor force proportion normally residing inside and outside overpressure contours of interest, to explore feasibility of "crowding" labor force by SIC codes[58/] and otherwise to facilitate effectiveness and management of the crisis-essential labor force.

15) Estimate commuting requirements for the crisis-essential labor force, inclusive of allowances for essential auxiliary personnel (fire, police, medical, transportation, public utility) for selected "crowding" ratios.
(Note: The 1970 Census questionnaire includes ZIP code identification of residence, place of employment, and eight means of transportation to work, on a sample basis.)

16) Nominate, in accordance with recommendations of federal CSP director, one or more metro areas (a) for which evacuation is desirable on the basis of Steps 2 to 11, and (b) has personnel especially imaginative and otherwise highly qualified, and (c) is currently involved in a CSP program.

17) From direct discussion with nominees, determine the degree of interest in the metropolitan area and state civil defense operating structure to having a contingency amendment to the CSP for the metro areas selected; and select at least one for a pilot study.

58/ In the Soviet Union, evacuation is planned by plant managers, who thus maintain close labor force control. For crisis conditions in the United States, for essential workers and priority commuting, the concept may be advantageous also for labor union-management combined planning.

18) Prepare, using NCDCF or other computer facilities to the maximum extent, detailed tabulations, by at least standard location detail, showing numbers to be evacuated; destination; existing NFSS spaces; home basement estimate; and expedient fallout shelter requirements, if any, for accommodation of evacuees. In this regard, special attention should be paid to existing mines and caves, data for which were collected in the early part of the NFSS program. (Note: 1970 Census map series are recommended to assist in this work, and to facilitate correlation with 1970 Census data.)

19) Amend or modify existing CSP contract scope of work for one or more areas, to permit alternative CSP (evacuation) pilot plans; initiate contract work.

20) Brief, or otherwise inform civil defense delegate agencies of progress.

21) Modify or amend the computer procedures based on contract pilot plan or plans.

22) Draft modifications to existing Federal Civil Defense Guide to accommodate evacuation as a CSP option.

23) Complete contract pilot plan.

24) Select one metro area from each Civil Defense Region in consultation with regional directors, using computations prepared earlier, but modified as necessary to incorporate pilot study experience.

25) Initiate pilot CSP-evacuation option planning in each region.

26) Prepare final modifications to Federal Civil Defense Guide.

27) Extend CSP-evacuation option to other areas identified in accordance with disclosed population objective.

The methodology outlined above is believed consistent with the constraints of a civil defense lifesaving program that excludes both active defense (ABM) for population, and urban blast shelter. The steps were formulated to build to a maximum extent on existing federal-regional-state-local civil defense know-how, and to avoid unrealistic charges of initiating a new, and seemingly contradictory civil defense program.

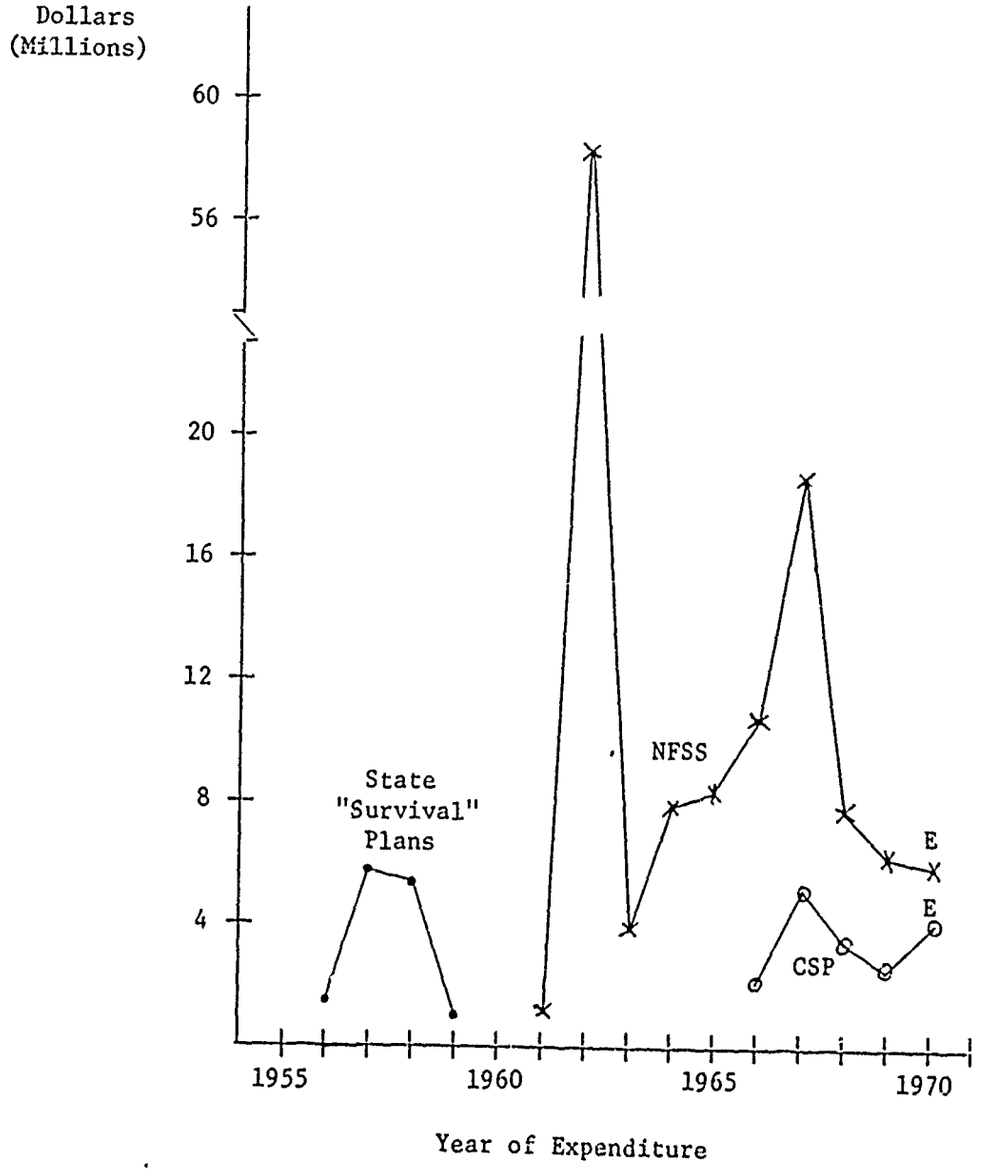
The population dispersion option is more correctly regarded as a part of a comprehensive CSP for some urban areas, not all. It is not applicable to all areas; but complements the National Community Shelter Planning program. It is a direct development from research and the CSP program.

The history of civil defense planning indicates that many years will be required to complete these or other local plans. An indication of the time required, assuming modest budgets, is suggested by Chart 18, "Annual Contract Expenditures for Selected OCD Programs." By the end of FY 1970, CSP's will be in process for about 109 million, but finished for about 25 million. On the other hand, Chart 18 illustrates the flexibility of OCD to respond to a crisis, such as 1961, and to expand a program from less than $1 million to $58 million in one year. Civil Defense resourcefulness in implementing a well-funded and explicitly directed program is considerable. The present CSP can be regarded as originating as early as 1962, and to be an outgrowth of at least three pilot or development programs. Under a "fifty city" CSP program, information and plans relevant to population movement to make maximum use of NFSS findings were developed for at least one urban area in each state. Beginning in early 1965, three communities were studied in depth--Atlanta, Des Moines, and Whatcom County. This included the development of a computer program to develop a theoretical plan for rapid shelter of the population while keeping total travel distance to a minimum. Concurrent with and supplementing these activities was an especially

Chart 18

Annual Contract Expenditures for Selected OCD Programs

(Excludes R & D Lead Times and Costs)



E - 1970 Budget Estimate. Independent Offices and Department of Housing and Urban Development: Appropriations for 1970 Page 872.

detailed civil defense plan for Montgomery County, Maryland. From these plans, and its more comprehensive activity, Emergency Operations Systems Development (EOSD), there were prepared a series of Federal Civil Defense Guides.

Analysis costs for movement alone, in conformance with the Guides, were estimated at $9 million from a planning allocation of $30 million to EOSD tasks.[59/] The balance of the $30 million would be required for related tasks, and planning necessary to enable the shelters to be utilized effectively. These tasks include warning, shelter management, rescue, maintenance of law and order, remedial movement, local communications, radiological defense system, engineering, emergency welfare service, emergency medical services, and others.

As of January 1968, Stanford Research Institute with the help of some 16 subcontractors had prepared some 4,500 pages of EOSD documentation. From that comprehensive effort and studies were developed the estimates that the "building of an attack activated system, able to respond effectively to a tactical warning, would cost $200 to $300 million per year over a five-year period in addition to the cost of overcoming the current deficit of shelters." [60/]

An alternative approach, the cost of providing a well planned system which could be built during a crisis with some minimal long lead time hardware requirements was estimated to cost approximately $30 million

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59/ Emergency Operations Systems Development-Movement to Shelter, Phase I Analytical Report, August 1965, p. 93.

60/ Emergency Operations Systems Development-Integration Task, Phase II, January 1968, p. 9.

per year over five years.[61] SRI's Phase II, EOSD Integration Task report went on to conclude that the "crisis activated system is the only viable approach, particularly under today's budgetary constraints." To a considerable extent, the present CSP and EOSD programs have continued to anticipate modifications in their concepts, and to incorporate them as appropriate.

To illustrate a methodology for integrating dispersal planning within the existing CSP procedures, reference is made to the diagram contained in National Community Shelter Planning Program, Federal Civil Defense Guide, Part D, Chapter 3, Appendix 1, and entitled "Community Shelter Planning Process (Directly Funded Local CSP)." That diagram outlines the work steps required for the CSP process, emphasizing use of NFSS spaces, many of which are located in central city areas. If the population of an urban area is to be dispersed to achieve a dispersal objective, the CSP may be prepared in two parts. The procedures for the one part are as presently set forth in the FCD Guide. The other part, dispersal, provides for substantial outward movement of population.

The following page, "Develop Dispersal Factors and Policies for Designated Areas--Federal Agency Responsibilities for CSP Dispersal Options under Directly Funded CSP," outlines in CSP format the analyses that may be taken before, during, or after the completion of a CSP that emphasizes inward movement utilizing NFSS spaces. By this means, maximum use continues to be made of the CSP know-how that has already been acquired over the last decade.

Use of the existing CSP structure for accomplishing plans for outward movements of urban population, in blast hazardous areas, is also appealing as a procedure for decreasing premature publicity. In view of Soviet urban evacuation planning, it may be desirable for the United States to have achieved an advanced stage of planning without knowledge of the general public. Publicity would destroy this advantage. No significant benefits can be identified to result from early public releases of this phase in planning.

61/ Ibid.

Outline to
Develop Dispersal Factors and Policies for Designated Areas--
Federal Agency Responsibilities for CSP Dispersal Option
(Directly Funded CSP)

REFINE AND APPLY
ALTERNATIVE TARGET ASSUMPTIONS
FOR THE COUNTRY
(DASH AND NAHICUS-TYPE)

CONDUCT SERIES OF SIMULATIONS
TO DETERMINE PATTERNS
OF 1, 3, AND 10 PSI GRADIENTS
FOR BLAST RISK AREA

FOR THESE AREAS, COMPUTE:
- TOTAL POPULATION
- TYPES OF INDUSTRY AND CAPACITY (SIC AND "SURVIVAL")
- EMPLOYMENT BY INDUSTRY
- NFSS SPACES, TOTAL AND UNDERGROUND
- OTHER SPACES, TOTAL AND UNDERGROUND

COMPUTE THE ABOVE QUANTITIES
FOR SELECTED DISTANCES
OUTSIDE THE 1 PSI OR OTHER GRADIENT
5, 10, 20 MILES

SELECT CURRENTLY AVAILABLE
PEOPLE-SHELTER OCD ASSIGNMENT
ALGORITHMS ("SAM" OR OTHER)

DESIGN AND PERFORM
PARAMETRIC ANALYSES OF IMPACT OF
ASSIGNMENTS FROM WITHIN
1, 3, and 10 PSI GRADIENT TO
- HOMES BETWEEN 1 PSI GRADIENT AND 5 MILES FROM IT
- 10 MILES FROM 1 PSI GRADIENT
- 20 MILES FROM 1 PSI GRADIENT
- UNIFORM DISPERSAL OVER THE STATE(S)
- UNIFORM DISPERSAL-ADJACENT STATES, TO ALTERNATIVE "CROWDING" RATIOS
- INCLUDE NFSS AND HFPS
- INCLUDE UNDERGROUND SPACES
- CALCULATE CASUALTIES UNDER EACH ALTERNATIVE

FORMULATE CRITERIA FOR EVALUATING
ALTERNATIVE PATTERNS OF URBAN AREA
DISPERSAL AND COMMUTING

TYPICAL CRITERIA:
- MOVE FAMILY A MAXIMUM AVERAGE OF 30 MILES (OR ALTERNATIVE DISTANCES) FROM PRESENT RESIDENCE
- MOVE FAMILY (WITHOUT BREADWINNER) UP TO 150 MILES (OR ALTERNATIVE DISTANCES) AND ASSUME WEEKEND COMMUTING
- SUBSTITUTE TRANSPORTATION TIME FOR DISTANCE
- LIVES "SAVED" COMPARED BY ALTERNATIVE CROWDING RATIOS
- ESSENTIAL URBAN INDUSTRY TO BE MAINTAINED IN PRODUCTION
- ESSENTIAL INDUSTRY LABOR FORCE TO COMMUTE
- NFSS SPACES IN DISPERSAL AREAS
- EXPEDIENT FALLOUT SHELTER NEEDS
- EXAMINE DISTANCE-TO-SHELTER-NEEDS PHASES
- PHASES FOR DISPERSAL (25%; 50%; 75%)

CHECK EXPECTED CASUALTY REDUCTIONS

RANK SMSA'S OR PORTIONS THEREOF
FOR WHICH PILOT DISPERSAL AND
SHELTER PLANS SHOULD BE DEVELOPED

DETERMINE STATUS OF CSP
IN SMSA'S RANKED, AND
SELECT ONE OR MORE

PRELIMINARY ALLOCATION OF
EVACUATED POPULATION, BY SL,
PREPARED BY COMPUTER
BY DISPERSAL PHASES
(25%; 50%; 75%)

INITIATE PLANNING ON SMSA'S
DESIGNATED FOR ALTERNATIVE
DISPERSAL PLANS

AMEND DIRECT FUNDING CONTRACT
FOR LOCAL CSP, AND
IMPLEMENT PROCEDURES IN FCD GUIDE,
"NATIONAL COMMUNITY SHELTER PROGRAM"

There is much to be gained by continuing to work within the CSP process. In many cases, CSP's are needed without change to existing guidelines. To disrupt the momentum and procedures already achieved in prepared CSP's for the balance of the nation might be disastrous to long-term objectives.

Selection of the cities, or more accurately the areas from which population would be evacuated, should be based on estimates of the probability of their relative exposure to blast and fire hazards. These procedures were described generally in Steps 1 to 10. It is understood that Office of Emergency Preparedness "NAHICUS" runs are being made for 1969-1970 for finer delineation of these cities or areas. These calculations can be supplemented by DASH runs for even smaller geographical area analyses; and if the OEP runs are not completed for any reason, by DASH runs directly. However, decision and action need not be delayed or deferred by OCD pending the completion of these new computations. Adequate information from the 1963-1965 runs exists. For the purpose of identifying areas of greatest blast hazard few areas will be added or deleted in entirety; changes can be anticipated in the boundaries of areas of hazard.

With further regard to the problem of nominating areas for pilot dispersal planning, and assuming that one or more are in blast hazardous areas, the more logical candidates are the 57 cities (of the 50-city effort), the five cities of the extensive "five city study," and the three special areas of Des Moines, Atlanta, and Whatcom County. These have been selected because of the vast amount of analysis and data collection already completed and invested in these areas. Additional candidates are Houston, and Montgomery County, because of similar data investments and studies that have been made for those areas; and Washington, D.C., because of federal employee control and all the complexities--two states,[62/] a downtown black population moving outward to white neighborhoods, transportation complexities, North-South midway position on basement frequency, and the administrative advantages of proximity to all key personnel.

62/ An SMSA movement and shelter complexity classification for the most populated 100 SMSA's (based on numbers of states involved and overlapping or "contested" host areas) has been prepared by SRI; 100 SMSA's now overlap within one state; 16 more now overlap within two or more states; 38 overlap to a minor degree; and the remainder, 36, overlap to such a degree as to warrant aggregation into 13 dispersal-shelter planning areas.

For each of the "five cities" a separate optional plan could be authorized. This additional requirement is a dispersion and shelter contingency plan, to the same level of detail as the CSP's for the five cities but as an option for crisis implementations. As a first step, because of lessons to be learned in technique-smoothing in progressing from DASH or NAHICUS calculations to standard location planning, it is recommended that one, and then several cities be selected as the pilot and prototypes for the balance.

Because of the extension of orientation beyond fallout shelter, it is imperative that local officials be involved. The timing of such involvement is critical. All computer planning should be completed prior to their involvement, including population dispersal allocations to standard location detail. In the event officials of a nominated city area are hostile or uncooperative to the preparation of such a contingency plan, it is believed that scarcity of resources would make it prudent to concentrate initial efforts on other cities. The single most important factor in trial selection of urban areas is the availability of knowledgeable, imaginative, and cooperative personnel in one federal-region-state-local chain. This factor is more critical than geophysical, demographic, socio-economic and jurisdictional factors. This conclusion is derived from the studies that have already been made by OCD, many of which are referenced herein, which indicate that dispersal plans are feasible, and that all such considerations can be surmounted, or subordinated, when confronted with the overriding objective of reducing lives lost to blast and fire effects.

The cost of obtaining the dispersed population posture can be broken into three broad categories:

1) Paper plans at the Federal level,
2) Additional pre-crisis preparedness costs, and
3) The crisis phase budget.

Preparation of the "paper plans" at the Federal level will necessarily involve classified materials and extensive use of the National Civil Defense Computation Facility. As a minimum, the paper plans would cover the following:

1) The first eleven steps, shown above (through casualty savings by optional "crowding" ratios), with estimates of lives saved, SMSA by SMSA, under one or more selected crowding ratios[63]--estimated cost, assuming government furnished computer equipment, $300,000.

2) Computer printouts, with illustrative maps for one metropolitan area, and "host" area to the standard location level of detail, showing alternative population dispersals, with host standard location, with PF and overpressure ratings of available, and estimated expedient shelter, as determined by computer--estimated cost, assuming GFE and a dispersing urban population of less than 1,000,000 population, $100,000.

3) On-site assistance in modifying a CSP plan to include dispersion from the risk area to the host area, together with preliminary estimates of expedient shelter requirements--cost, $150,000.

Total paper planning, recommended to be performed under contract of the general type used in State Survival, NFSS, and CSP program developments, and with parts 1 and 2 completed within one calendar year, and work started on the detailed metro area within the first calendar year--cost, $550,000.[64]

This estimate does not include costs of reviewing and modifying present federal emergency system guidance to insure compatability with crisis dispersal of population, and with particular emphasis on interim, expedient measures for life-sustaining resources control. Related federal planning is in an advanced stage of completion, and relies heavily on State operating centers for decentralized administration. Prototype plans for eight localities, one in each region, are being made under OCD leadership and guidance. Although the plans are based on the assumption of use in a

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[63] All of these calculations need not be completed in detail prior to preparation of illustrative maps and standard location allocations for a pilot metropolitan area.

[64] Based on the $300,000 recommendation for computer-assisted alternatives. The larger amount is the best opportunity for effecting savings throughout the entire program. It will facilitate designing dispersal phases to specific SMSA and surrounding area constraints, as not all SMSA's would be expected to be uniformly evacuated, in the same time, to a common mean distance.

postattack nuclear war, many features are applicable to a pre-attack crisis. In the past, this aspect of OEP-OCD planning coordination, as well as the related civil defense work of other agencies, has been largely carried on by regularly assigned staff without special funding for contract support. It has therefore not been costed. Continued OCD personnel reductions suggest that it may become necessary to consider contract support for essential analysis and modification to existing resource management plans of State and national government. In the absence of interim or expedient plans, it is doubtful if population dispersal would be regarded as a reasonable option at the highest political levels.

Assuming a pre-crisis preparedness status to be achieved in five years, a comprehensive budget estimate of additional costs has been formulated. It is based on the continuation of a non-crisis OCD budget at the approximate present annual level of $70 to $75 million. The key estimates are listed below:

	$ Millions
Total Five Years Pre-Crisis Preparedness	280
Offsets from Present Programs	- 30
Additional Net Cost	250
Annual Costs	50
Additional Research for Fire and Blast Slanting	10
Additional Net Annual Cost	60

Details of the budget estimate as summarized above are given in Table 15, "Estimated Additional Costs of Obtaining Minimum Pre-Crisis Preparedness Within Five Years."

Table 15

Estimated Additional Costs of Obtaining Minimum Pre-Crisis Preparedness Within Five Years

1970-1975

		$ Millions
SHELTER	Identify and Update @ $.20*	40
	Plan @ $.15	30
	Material Support @ $1.00* (Prepositioned supplies or substitute means for obtaining food, water, medical requirements)	100
EMERGENCY INFORMATION	"CSP" prints @ $.02-1/2*	5
	AM FM @ $.02-1/2* (Prepositioned) TV	5
RADEF		25
TRAINING AND EDUCATION		25
EMERGENCY HOSPITAL AND MEDICAL STOCKPILE		50
TOTAL PRE-CRISIS PREPAREDNESS		280
(ANNUAL COSTS ---		56)
OFFSETS FROM PRESENT PROGRAM		
Shelter Survey	10.0	
Emergency Information	2.5	
RADEF	10.0	
Training and Education	7.5	
	30.0	(30)
(ANNUAL OFFSET ---		6)
ANNUAL PRE-CRISIS PREPAREDNESS		50
Plus research, especially fire and blast slanting		10
Additional Net Annual Cost		60

* Per capita estimates, for approximately 100 million persons closely affected, and an additional 100 million less directly concerned.

Special attention is called to the fact that the data base accumulated by OCD as a part of the NFSS program is becoming outdated. To maintain a state of readiness, and to increase the validity of planning, it is believed that an amount of $10 to $20 million will be required soon to update the NFSS and other data; and in addition, some $5 million appear necessary to check and update existing medical supplies. The longer the time that elapses, the more necessary these updating expenditures will become, and probably the greater. Assuming the data base is updated within the next two years, the five year program can be initiated at any time between the present and 1975. However, delay forfeits possible economies from combining CSP with the dispersal option.

At any one time, it should be anticipated that a crisis might occur that involves dispersal of the population from high risk areas. To provide guidance in meeting such an emergency, a Crisis Phase Budget has been estimated. It is shown in Table 16. This budget assumes that paper planning at the Federal level has been completed, or is well in progress, and that serious pre-crisis preparedness measures, costing in the order of $50 million more than the present $70 to $75 million level, have been initiated. This crisis budget would provide the funds for implementing the paper plans, including initiation of construction of expedient shelter. The crisis budget assumes a high level of previous planning,[65/] and maximum encouragement by the President for all to respond to a national emergency.

All costs are not shown, as not all costs will be passed back to government. The Gross National Product accounting mechanism is a poor measure of volunteer efforts and other costs to be offset by the value of the lives to be saved by the national effort. It is noted, however, that Federal planning contemplates a continuation of essential production, and a re-direction of production, food distribution, transportation, and

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65/ If this assumption is invalid, the preceding budget, "Estimated Additional Costs of Obtaining Minimum Pre-Crisis Preparedness Within Five Years," may be used to estimate additional crisis costs for planning. The additional funds cannot buy time; the resulting plans may not be worth their cost.

Table 16

Crisis Phase Budget

(Deployment and Implementation of Plans)

	$ Million
Emergency Update	30.0
Transportation of People	25.0
Life Support (Claims for Excess Redistribution Cost)	100.0
Instrument Check - RADEF	5.0
Warning System Check	0.1*
Emergency Communications Check	0.1*
Training and Education (TV Instruction)	1.0*
Administration	13.8
Accelerated Production Orders (Medical Supplies)	100.0
	275.0
Expedient Shelter - Corps of Engineers as Administrative Agent	225-500

TOTAL - CRISIS DEPLOYMENT ONLY $500 - $775 MILLION

* Assumed always in a high state of readiness from present program.

other activities. Pending completion of Federal agency plans, it is feasible to anticipate some expansions from increased production in the non-urban areas that might be achievable by plants not in blast hazard risk areas.

Costs have not been estimated in these budgets for the efforts of Federal agencies with civil defense responsibilities, or otherwise affected by dispersal planning. By comparison with OCD total costs, they are relatively minor efforts. At most, the Federal plans for such agencies as Office of Emergency Planning, and Departments of Agriculture, HUD, HEW, DOT, Interior, Labor, Commerce, and others involve costs aggregating few millions of dollars. Many of these costs are now being borne as a part of current civil defense and Office of Emergency Preparedness responsibilities. The necessary re-direction of these efforts to include the dispersal contingency need not involve extensive additional budgeting.

The Office of Civil Defense would, of course, acquire additional significant responsibilities for developing, clarifying, and coordinating the impact of dispersal planning on these Federal agencies. Additional OCD staff would therefore be required, but the numbers are not believed to be in excess of ten to 20 professionals. Except for key central decisions and monitoring, much of the work may be contracted to be accomplished by State and/or local government and private firms in the same way as State Survival Planning, NFSS, and the current CSP efforts were performed. To the extent that the contracting procedure is followed, OCD can conserve its in-house manpower for the more fundamental job of providing direction and coordination with other Federal, regional, state, and local efforts.

A dispersion and shelter program acknowledges many difficulties--personal hardship, cost, and an unknown but manageable degree of national disruption. It invites destructive criticism from the ostensibly well-informed, who feel no compulsion or responsibility to advance more feasible alternatives. Less destructive, but nonetheless hostile and real questioning can be anticipated in the competition for dwindling budgeting resources. The trend of decreasing civil defense popularity, as measured in federal funding, that has marked the decade of the 1960's can be expected to continue in the 1970's.

Unless carefully planned, and supported by hard factual considerations and further analyses as outlined herein, it may succumb to the hardships of the political environment.[66/]

Nevertheless, a dispersion and shelter program should be considered seriously, despite its unpopularity. The estimated additional 50 million survivors made possible by such a program could well be the difference between a viable postattack nation and one which is damaged beyond recovery. Problems, difficulties, and obstacles to saving that number of lives, and contributing to national integrity become relatively minor when viewed in perspective. The temptations of a decision to defer action on a change in CSP emphases are equivalent to a decision to do nothing. Fortunately, the economics of long lead time civil defense programs tend to require relatively small fund allocations in the early stages, and CSP projects for the larger, and more dangerous areas are not completed. The computer-assisted analyses, as described earlier, involve relatively modest expenditures. The hazards are such that we cannot afford to be without options to our present course and commitments.

66/ An Overview of Political, Social and Public Acceptance of Civil Defense, System Sciences, Inc., September 4, 1969, p. 34. (Prepared for the "Lincoln" Study.)

Chapter 6

Conclusions and Recommendations

Civil defense planning expectations have changed markedly since the initiation of the present program featuring National Fallout Shelter Survey and Community Shelter Planning. Among the changes are the growing expectation of days and weeks of possible strategic warning prior to an all-out attack, the nationwide availability of high-quality fallout shelter in greater numbers than originally anticipated (with the complicating danger that it tends to be concentrated in central city areas) and the indefinite deferment of ABM defenses and of blast shelters for the protection of urban populations.

While these changes have been taking place, civil defense planning oriented to intensive use of structures offering protection against fallout has continued. The SAFEGUARD deployment decision, made in 1969, now suggests that for many areas, particularly those most likely to suffer blast damage, there simply will be no protection.

A moderate to large Standard Metropolitan Statistical Area typically includes about thirty percent of the total population within a three or four mile radius from the city center. That same area typically includes about eighty percent of the NFSS spaces. Obviously any plan to make intensive use of existing fallout resources will increase the vulnerability to blast effects on population in the most attractive urban targets, the central cities. In an all-out attack on the United States, if this plan is carried out, the result may be more casualties than if there had been no plans at all because an inward movement and a heavy concentration of population in central city shelters would have located populations where protection existed against fallout but not against blast or fire.

To prevent the occurrence of such a catastrophe a civil defense option must be found and provided for in the plan.

An extensive series of detailed analysis of population relocations under crisis conditions is a part of civil defense research literature and the "Survival Plans" of the 1950-1960 decade are also available. The more pertinent reports have been prepared by the Hudson Institute, the Dikewood Corporation, Stanford Research Institute, Institute for Defense Analyses, and Research Triangle Institute. These studies have analyzed aspects of evacuation of many central cities including the densely populated Northeastern part of the United States and they indicate or conclude generally that urban dispersal is feasible and that there are sufficient resources to relocate the urban population, or significant portions thereof, in rural and smaller urban areas.

The intensive use of homes easily accessible to major highways can facilitate commuting for essential workers. The housing load factor ratios* associated with such relocations would be comparable with the current housing intensity prevailing in such countries as Czechoslovakia, Finland, and the U.S.S.R., and are consistent with emergency housing standards of the Department of Housing and Urban Development.

The experience of past civil defense programs such as NFSS, HFPS, and expedient fallout shelter programs, indicates that within a relatively brief period of time, fallout shelter can be improvised to meet the needs of both host and evacuees.

There are significant fractions of industrial capacity already located outside of metropolitan or urban areas. These resources can be used more intensively to meet critical production needs. Further the normal "production capacity" is typically only about half that of "emergency production capacity" so that output limitations, if any, will be for reasons other than adequacy of plants and equipment.

All the above seem to indicate that resources and means exist to meet "crisis" fallout shelter and other needs of hosts and evacuees, that there

*Load factor $= \frac{\text{occupants of dwellings during an emergency}}{\text{occupants of dwellings before an emergnecy}}$

are significant reserves to facilitate and maintain population relocation and with essential production continued and even expanded by commuting-to-work arrangements, the United States, if attacked will be better prepared to survive and to recuperate.

While in the past years, in the United States, evacuation of population has been abandoned in favor of sheltering as an effective countermeasure to save lives during an all-out war, the U.S.S.R. has continued a vigorous program of population dispersal as part of its civil defense plan. All cities have detailed plans to gather the inhabitants at certain centers known to all. From there transportation has been prearranged, following special routes to the reception areas where preparations also have been made to accommodate the evacuees. Dispersal then is an integral part if not the most important part of Soviet civil defense.

The implications, especially strategic, for the United States are obvious. With the Soviet population dispersed and ours concentrated in fallout shelter in city centers, our posture would certainly be less favorable should some last moment bargaining be called for. The United States therefore should have at least a similar rudimentary countermeasure as a bare minimum.

It was pointed out that a 75 percent evacuation with no fallout shelter provided in the reception area could mean the savings of lives for 20 percent of the preattack population; by providing a protection factor of 20 in reception areas an additional 20 percent fatalities could be avoided. If dispersal of population is so effective in saving lives, why should it not be included in Community Shelter Planning. It sounds logical that a mix of life saving countermeasures would be a wise course to follow; a dispersal and shelter option.

It is believed that with all the investment which OCD has in CSP the latter could simply be modified adding new directives including a dispersal option for areas to be designated by the Federal Government. A "new" program is not required. Dispersal planning should be built directly on the existing foundations of CSP research, operational planning, know-how, administrative practices and relationships.

The following recommendations are made based on the results of this study:

(1) As a minimum, a standby crisis preparedness consisting of the computation of high blast risk areas versus their respective host areas, for each SMSA and down to the Standard Location, is recommended to be initiated immediately. Emphasis should be on extensive application of computer techniques developed using DASH and NCDCF. This standby preparedness can be restricted to federal officials. However, the computations should be designed so that they can serve the purpose of preparing federal guidance necessary to the dispersal option required as a part of a comprehensive CSP for selected urban areas.

(2) As a minimum, concurrently and independently from the above guidance computations it is recommended that the allocations and priority plans already prepared by the States be analyzed from the viewpoint of OCD's responsibilities, (a) to determine compatibility with a crisis dispersal of population strategy and (b) to develop emergency modifications or guidances necessary for control and use of life sustaining resources during a preattack crisis and through an immediate postattack period.

Major changes in the existing system should be avoided, only necessary modifications should be responsive to the emergency missions of other government agencies as stipulated in various contingency plans. Interagency participation is as critical here as that of OCD leadership.

(Note: This is an important long lead time subject that can only be performed comprehensively prior to a crisis. The availability of a preattack crisis allocation and control procedure will be an important factor in decision making at the highest political levels during an emergency.)

Appendix A

Comparison of Housing Unit Damage in Selected SMSA's from the OPAL '61 Attack and the UNCLEX '66 Attack

Comparison of Housing Unit Damage in Selected SMSA's

from the

OPAL '61 Attack and the UNCLEX '66 Attack

Region	State	SMSA		Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
1	Conn.	111	Bridgeport	58.6	100.0
		112	Hartford	93.2	98.6
		113	New Haven	72.7	100.0
	Maine	121	Portland	80.5	0.0
	Mass.	131	Boston	36.5	99.0
		132	Brockton	7.6	100.0
		133	Fall River	36.9	100.0
		134	Pittsfield	69.5	0.0
		135	Springfield	98.4	100.0
		136	Worcester	28.5	97.7
	N.H.	141	Manchester	3.7	0.0
	N.J.	151	Allentown	34.6	0.0
		152	Atlantic City	0.0	0.0
		158	Trenton	71.3	100.0
	N.Y.	161	Albany	1.0	85.7
		162	Binghamton	1.4	89.5
		163	Buffalo	10.4	95.3
		164	New York	97.5	85.4
		165	Rochester	0.0	100.0
		166	Syracuse	77.0	78.3
		167	Utica	0.0	62.9
	R.I.	171	Providence	96.1	92.0
	Vt.		No SMSA's		
2	Del.	211	Wilmington	96.5	97.9
	D.C.	220	District of Columbia	99.4	100.0
	Ky.	231	Cincinnati	92.4	98.2
		232	Evansville	100.0	0.0
		233	Huntington	70.3	100.0
		234	Lexington	0.0	100.0
		235	Louisville	100.0	99.6
	Md.	241	Baltimore	88.3	96.9
		242	Washington	69.5	98.6

Comparison of Housing Unit Damage in Selected SMSA's

from the

OPAL '61 Attack and the UNCLEX '66 Attack

Region	State		SMSA	Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
2	Ohio	251	Akron	99.2	100.0
		252	Canton	86.9	82.6
		253	Cincinnati	99.8	99.4
		254	Cleveland	96.3	99.0
		255	Columbus	0.0	100.0
		256	Dayton	87.7	91.0
		257	Hamilton	55.3	100.0
		258	Huntington	45.1	90.6
		259	Lima	0.0	0.0
		25A	Lorain	87.1	100.0
		25B	Springfield	2.1	100.0
		25C	Toledo	98.6	99.6
		25E	Youngstown	83.8	97.9
	Pa.	261	Allentown	92.6	94.7
		262	Altoona	96.5	0.0
		263	Erie	81.4	82.8
		264	Harrisburg	73.2	90.2
		265	Johnstown	61.9	73.2
		266	Lancaster	80.3	24.0
		267	Philadelphia	86.1	97.9
		268	Pittsburgh	72.7	92.2
		269	Reading	74.2	98.6
		26A	Scranton	0.0	100.0
		26B	Wilkes-Barre	74.0	77.1
		26C	York	75.8	97.1
	Va.	271	Hampton-Newport News	96.1	100.0
		272	Norfolk	98.4	84.6
		273	Richmond	2.9	99.6
		274	Roanoke	100.0	0.0
		275	Washington	59.8	97.9
	W.Va.	281	Charleston	57.2	86.9
		282	Huntington	77.1	90.8

Comparison of Housing Unit Damage in Selected SMSA's

from the

OPAL '61 Attack and the UNCLEX '66 Attack

Region	State		SMSA	Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
3	Ala.	311	Birmingham	53.1	98.8
		312	Columbus	76.0	90.4
		313	Gadsden	0.0	100.0
		314	Mobile	91.8	0.0
		315	Montgomery	0.0	96.7
	Fla.	321	Jacksonville	100.0	98.8
		322	Miami	100.0	100.0
		323	Orlando	88.1	34.0
		324	Tampa	38.9	33.0
	Ga.	331	Atlanta	93.8	89.1
		332	Augusta	100.0	100.0
		333	Chattanooga	31.3	58.4
		334	Columbus	77.3	100.0
		335	Macon	0.0	0.0
		336	Savannah	99.4	87.7
	Miss.	341	Jackson	0.0	81.8
		342	Rankin	0.0	73.0
	N.C.	351	Asheville	0.0	0.0
		352	Charlotte	96.9	96.9
		353	Durham	97.5	0.0
		354	Greensboro	91.2	0.0
		355	Raleigh	91.2	0.0
		356	Winston-Salem	97.5	0.0
	S.C.	361	Augusta	88.1	73.6
		362	Charleston	88.1	87.9
		363	Columbia	0.0	76.6
		364	Greenville	0.0	0.0
	Tenn.	371	Chatanooga	93.0	85.2
		372	Knoxville	87.5	46.9
		373	Memphis	0.0	98.0
		374	Nashville	95.1	100.0

Comparison of Housing Unit Damage in Selected SMSA's

from the

OPAL '61 Attack and the UNCLEX '66 Attack

Region	State	SMSA		Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
4	Ill.	415	Davenport	0.0	97.3
		416	Decatur	0.0	100.0
		417	Peoria	0.0	95.3
		418	Rockford	0.0	100.0
		419	St. Louis	66.4	84.8
		41A	Springfield	88.1	92.8
	Ind.	422	Evansville	100.0	0.0
		423	Ft. Wayne	0.0	99.0
		424	Indianapolis	100.0	100.0
		425	Louisville	91.6	96.9
		426	Muncie	91.4	100.0
		427	South Bend	95.9	100.0
		428	Terre Haute	0.0	0.0
	Mich.	431	Bay City	0.0	95.1
		432	Detroit	91.8	99.8
		433	Flint	100.0	100.0
		434	Grand Rapids	88.5	0.0
		435	Jackson	0.0	100.0
		436	Kalamazoo	0.0	100.0
		437	Lansing	0.0	72.7
		437	Saginaw	11.9	96.5
	Minn.	441	Duluth	53.7	0.0
		442	Minneapolis	25.0	95.1
	Wis.	451	Duluth	87.3	0.0
		452	Green Bay	0.0	0.0
		453	Kenosha	0.0	81.4
		454	Madison	82.4	89.3
		455	Milwaukee	9.2	95.7
		456	Racine	0.0	88.3
5	Ark.	511	Fort Smith	100.0	0.0
		512	Little Rock	99.8	100.0
	La.	521	Baton Rouge	100.0	100.0
		522	New Orleans	97.1	100.0
		523	Shreveport	87.9	86.7

Comparison of Housing Unit Damage in Selected SMSA's
from the
OPAL '61 Attack and the UNCLEX '66 Attack

Region	State		SMSA	Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
5	N.M.	531	Albuquerque	97.9	98.6
	Okla.	541	Oklahoma City	96.9	0.0
		542	Tulsa	96.5	87.5
	Texas	551	Amarillo	89.8	0.0
		552	Austin	100.0	100.0
		553	Beaumont	69.5	98.6
		554	Corpus Christi	87.5	0.0
		555	Dallas	100.0	88.7
		556	El Paso	98.4	97.9
		557	Fort Worth	99.4	93.8
		558	Galveston	100.0	95.3
		559	Houston	64.1	99.2
		55A	Laredo	0.0	0.0
		55B	Lubbock	0.0	0.0
		55C	San Angelo	0.0	0.0
		55D	San Antonio	100.0	99.0
		55E	Waco	1.2	0.0
		55F	Wichita Falls	0.0	0.0
	Col.	611	Denver	98.4	90.0
		612	Pueblo	0.0	0.0
	Iowa	621	Cedar Rapids	0.0	98.0
		622	Davenport	0.0	97.5
		623	Des Moines	0.0	97.7
		624	Dubuque	82.4	0.0
		625	Omaha	84.6	80.3
		626	Sioux City	0.0	0.0
		627	Waterloo	0.0	100.0
	Kan.	631	Kansas City	96.1	87.7
		632	Topeka	99.0	0.0
		633	Wichita	0.0	99.4
	Mo.	641	Kansas City	95.5	97.7
		642	St. Joseph	0.0	0.0
		643	St. Louis	100.0	93.4
		644	Springfield	0.0	0.0

Comparison of Housing Unit Damage in Selected SMSA's

from the

OPAL '61 Attack and the UNCLEX '66 Attack

Region	State		SMSA	Housing Units Sustaining Blast and/or Thermal Damage (%) OPAL-61	UNCLEX-66
6	Neb.	651	Lincoln	97.3	100.0
		652	Omaha	98.4	100.0
	N.D.		No SMSA's		
	S.D.	671	Sioux Falls	0.0	0.0
	Wyo.		No SMSA's		
7	Ariz.	711	Phoenix	76.2	92.6
		712	Tucson	92.6	94.9
	Calif.	721	Fresno	0.0	70.1
		722	Los Angeles	0.0	98.0
		723	Sacramento	95.5	96.9
		724	San Bernadino	71.5	67.8
		725	San Diego	30.5	91.0
		726	San Francisco	2.7	97.1
		727	San Jose	0.0	97.7
		728	Stockton	0.0	0.0
	Nev.		No SMSA's		
	Utah	741	Ogden	0.0	0.0
		742	Salt Lake City	4.1	100.0
8	Idaho		No SMSA's		
	Mont.		No SMSA's		
	Oregon	831	Portland	84.0	90.0
	Wash.	841	Portland	94.3	86.9
		842	Seattle	2.0	87.3
		843	Spokane	98.8	97.5
		844	Tacoma	95.3	96.9

Appendix B

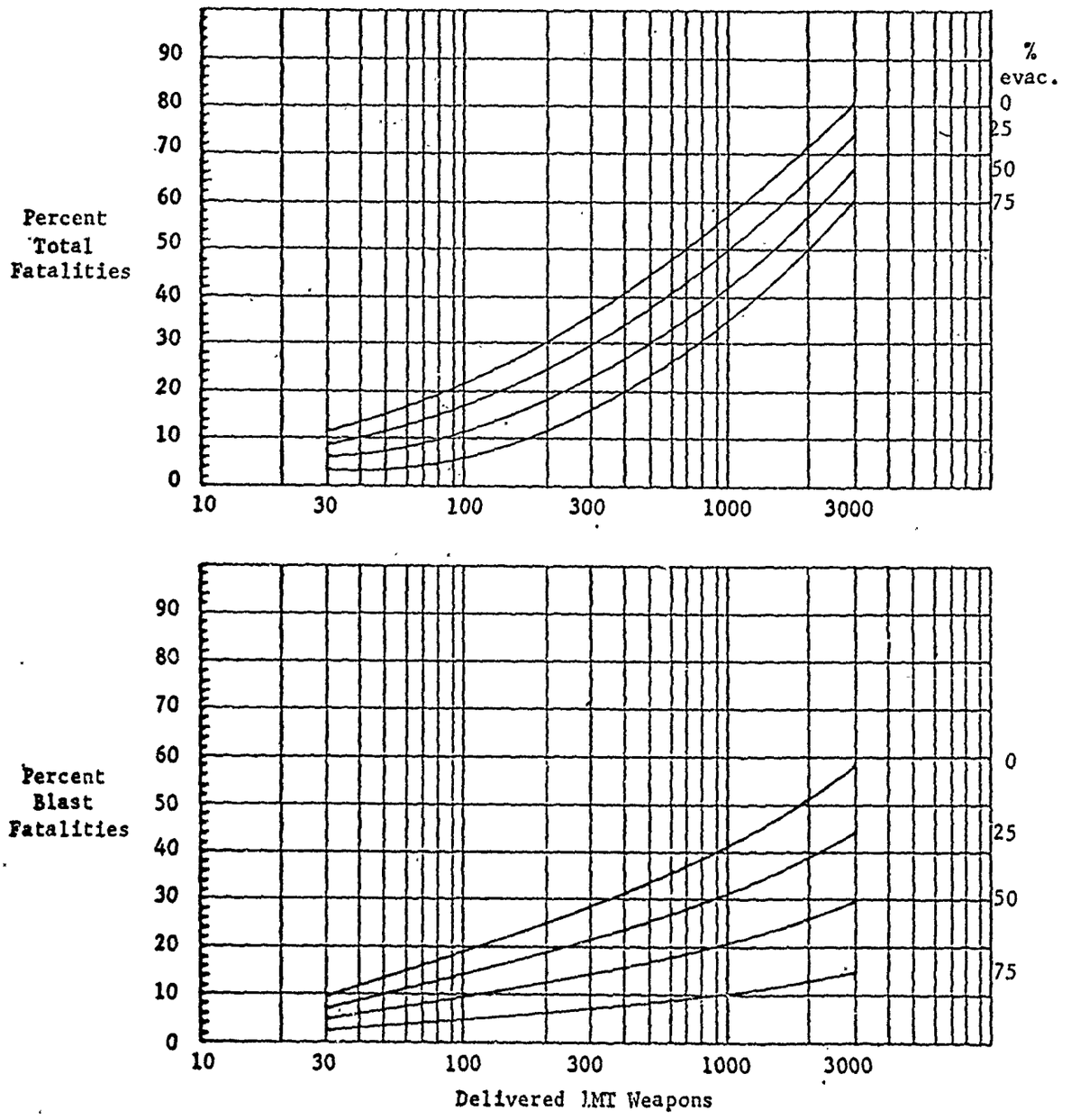
The following charts show graphically the trade-offs between increased urban shelter protection and increased urban evacuation as a function of size of attack and amount of rural protection. The tables from which the charts were constructed are Tables 22 through 29, pages 27 through 34 of "Applications of DASH for Shelter Program Analysis," 14 November 1969, prepared for Office of Civil Defense by System Sciences, Inc., and copies of which were delivered to Policy and Programs; Director of Research; and Contracting Officer's Technical Representative of this project.

Chart	Urban Shelter	Rural Shelter
B-1	Above ground shelters and Homes	Homes above ground
B-2	Above ground shelters and Homes	Homes below ground
B-3	Below ground shelters and Homes	Homes above ground
B-4	Below ground shelters and Homes	Homes below ground
B-5	25 psi blast shelters	Homes above ground
B-6	25 psi blast shelters	Homes below ground
B-7	50 psi blast shelters	Homes above ground
B-8	50 psi blast shelters	Homes below ground

Chart B-1

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 50 % at 7 PSI 40 PF*
50 % at 4 PSI 2 PF
Rural 100 % at 2 PF

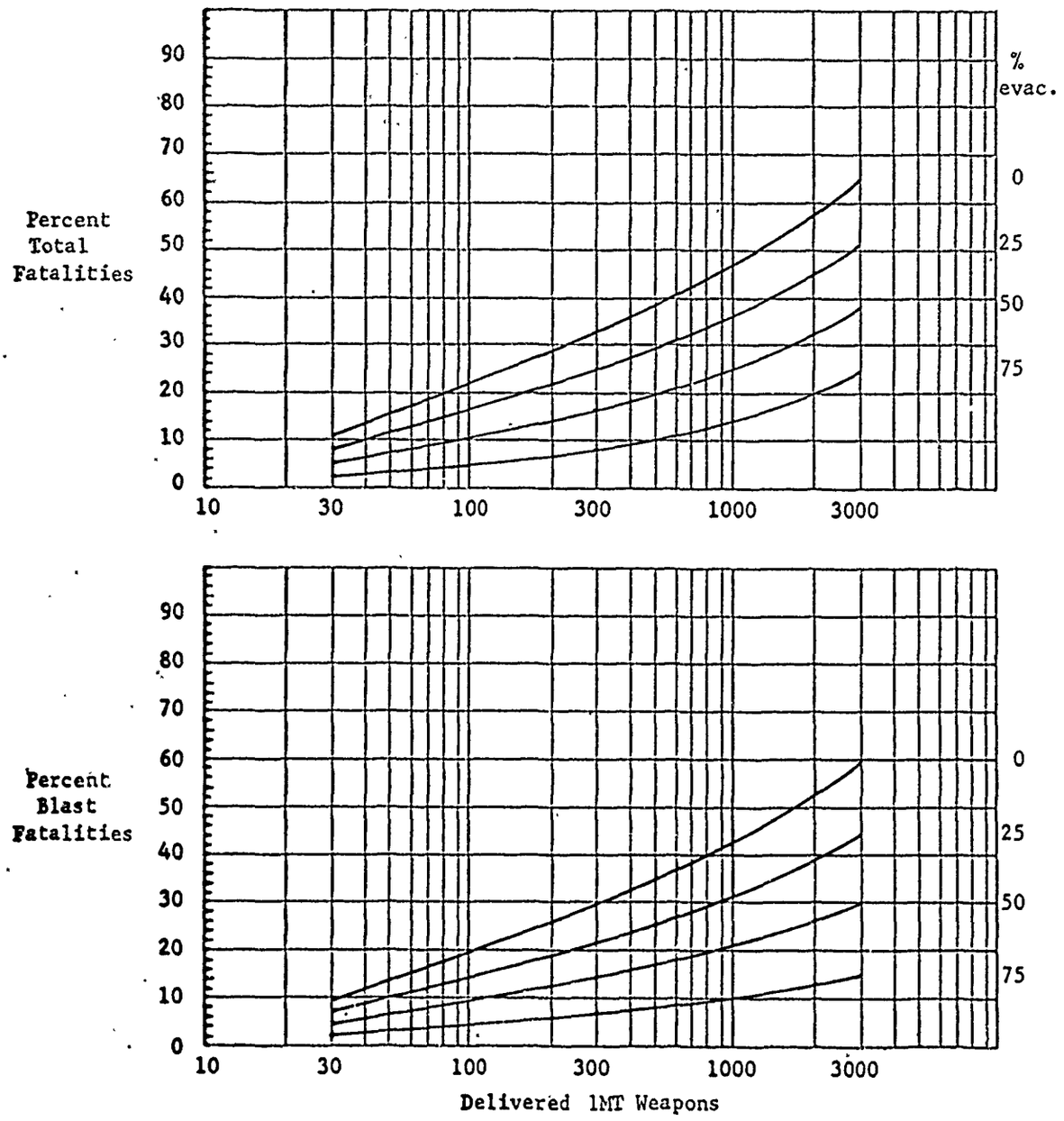


* Urban Shelter, above ground shelters and homes; Rural Shelter, homes above ground.

Chart B-2

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 50 % at 7 PSI 40 PF*
50 % at 4 PSI 2 PF
Rural 100 % at 20 PF

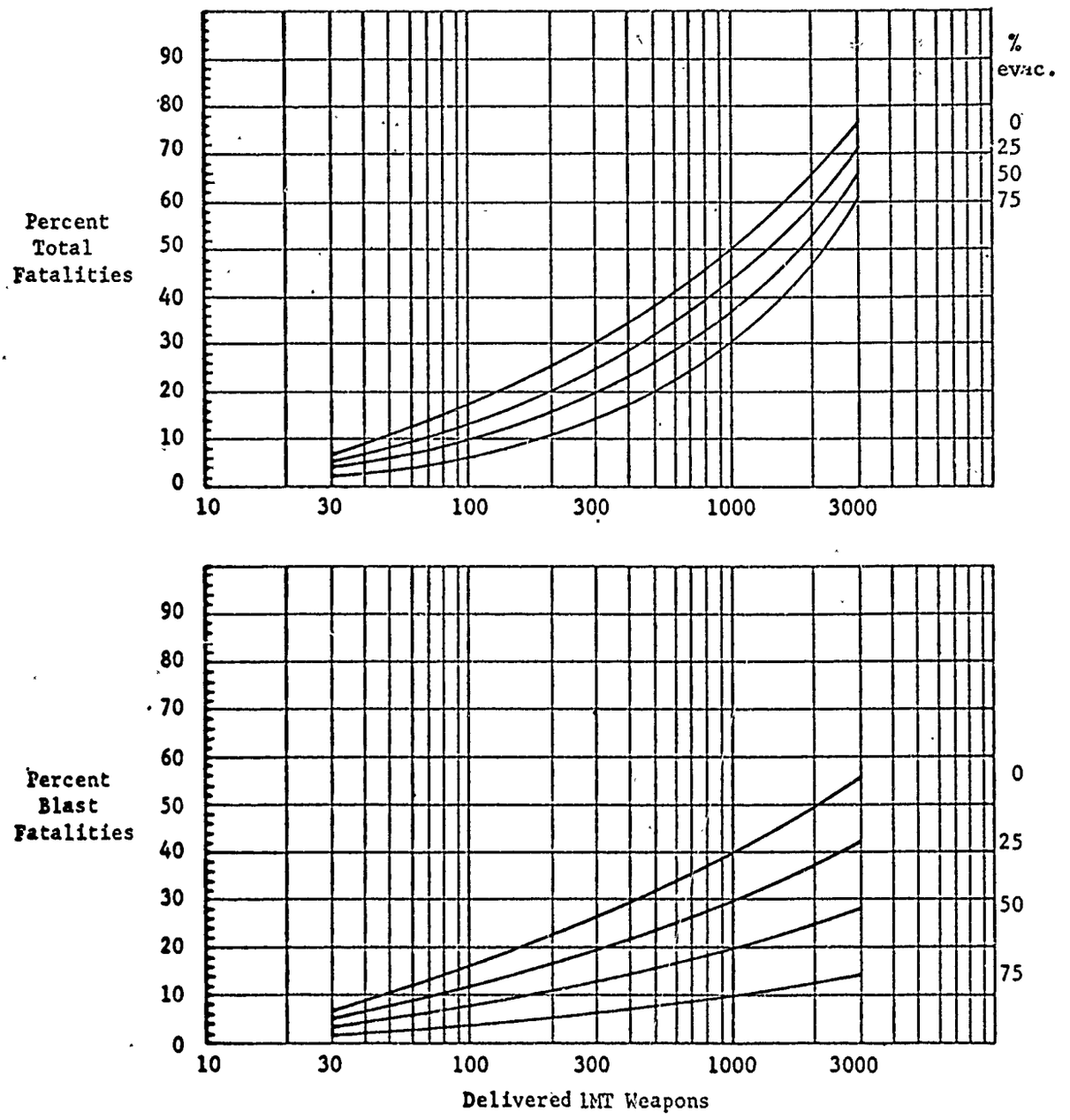


* Urban Shelter; above ground shelters and homes; Rural Shelter, homes below ground.

Chart B-3

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 50 % at 12 PSI 350 PF*
50 % at 4 PSI 30 PF
Rural 100 % at 2 PF

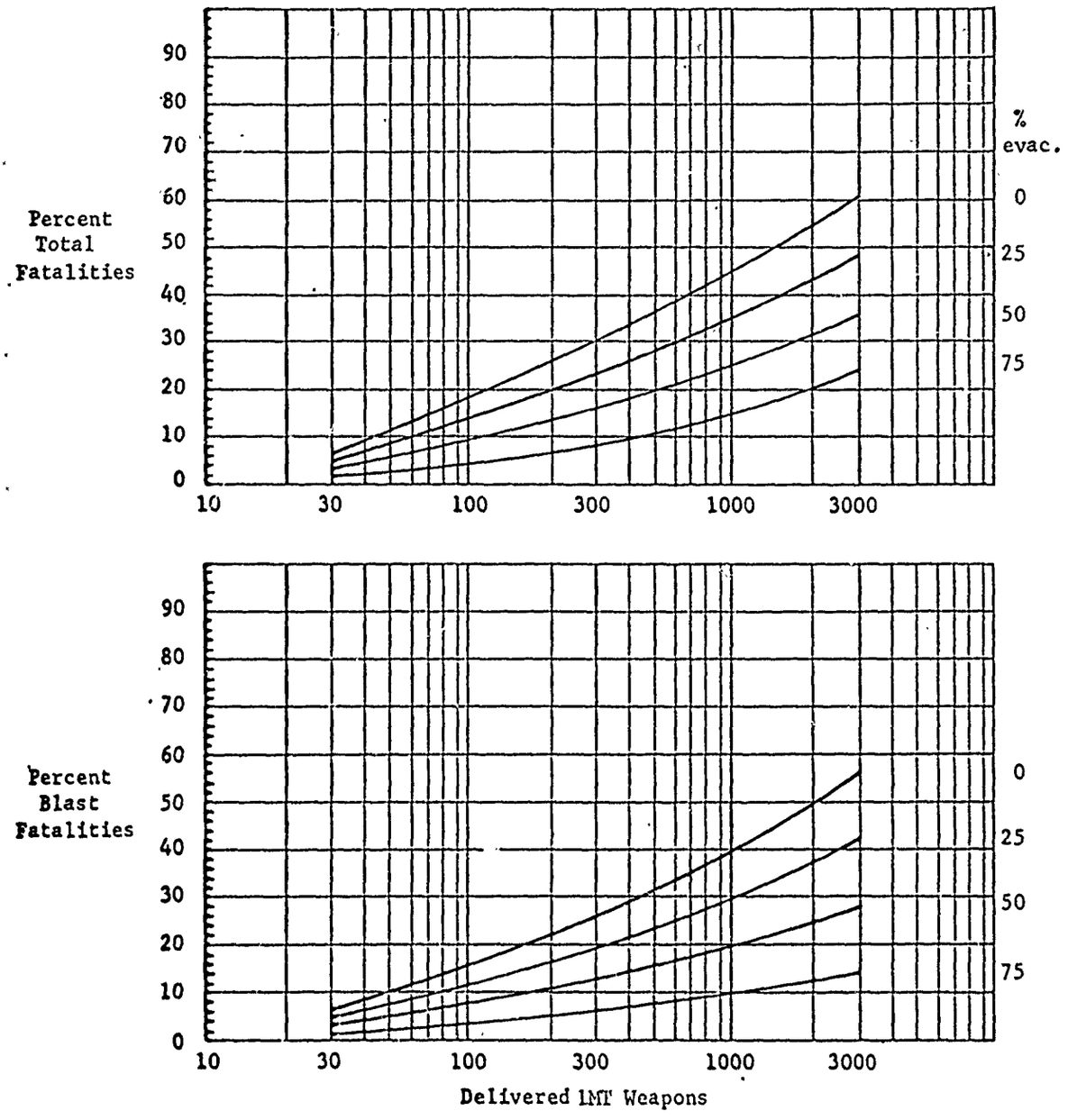


* Urban Shelter, below ground shelters and homes; Rural Shelter, homes above ground.

Chart B-4

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 50 % at 12 PSI 350 PF*
50 % at 4 PSI 30 PF
Rural 100 % at 20 PF

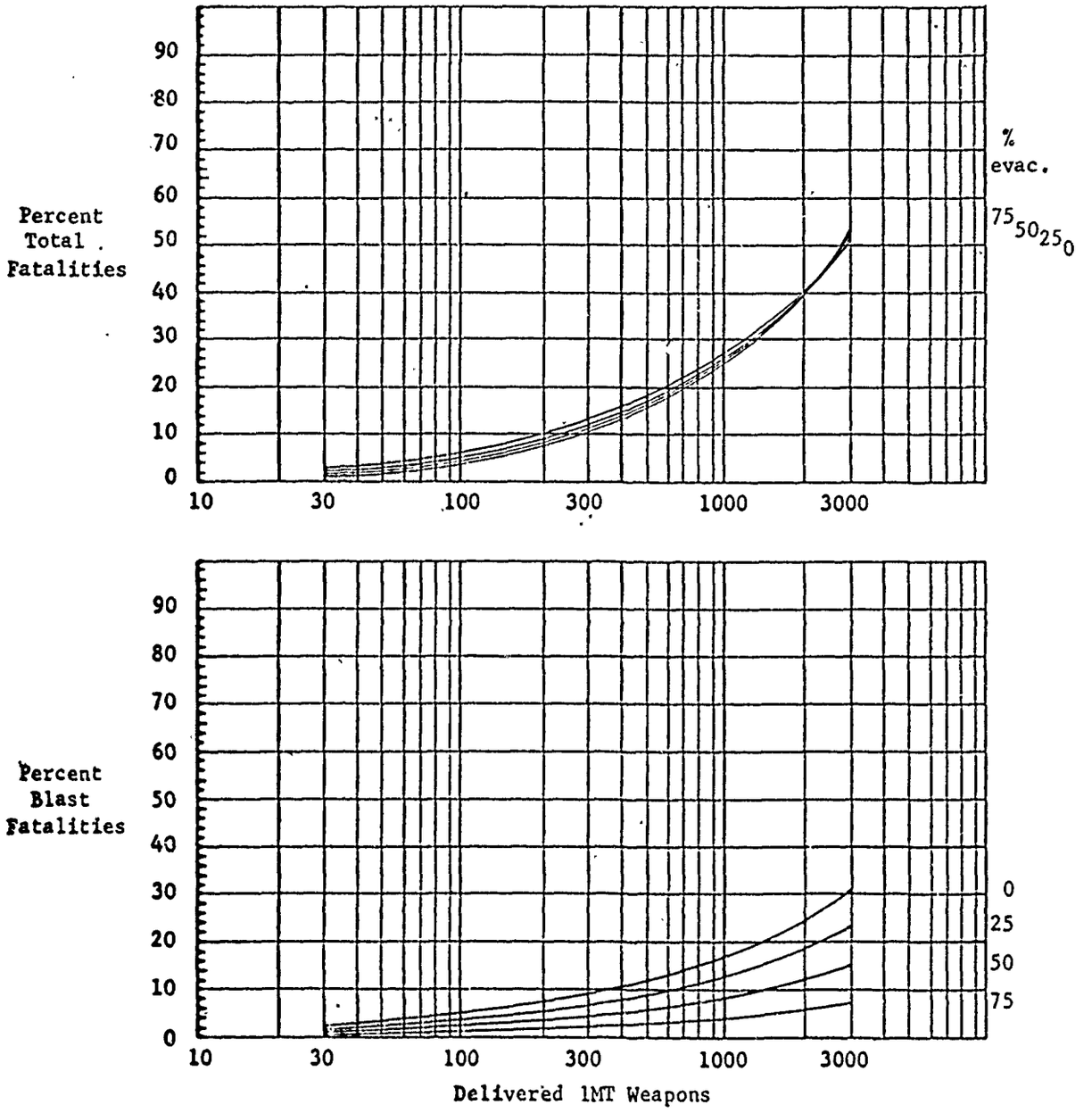


* Urban Shelter, below ground shelters and homes; Rural Shelter, homes below ground.

Chart B-5

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 100 % at 25 PSI 500 PF*
% at PSI PF
Rural 100 % at 2 PF

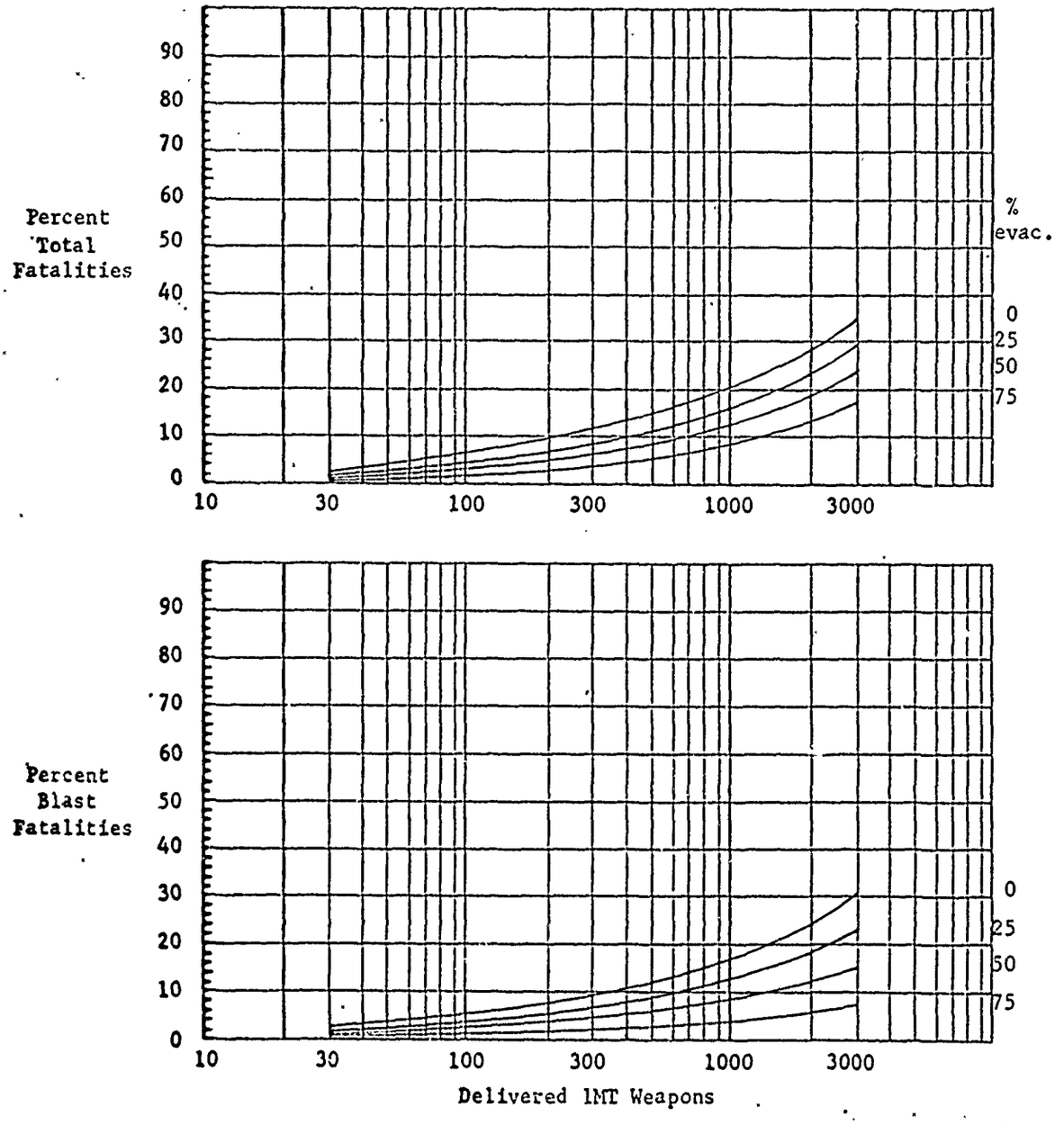


* Urban Shelter, 25 psi blast shelters; Rural Shelter, homes above ground.

Chart B-6

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 100 % at 25 PSI 500 PF*
% at PSI PF
Rural 100 % at 20 PF

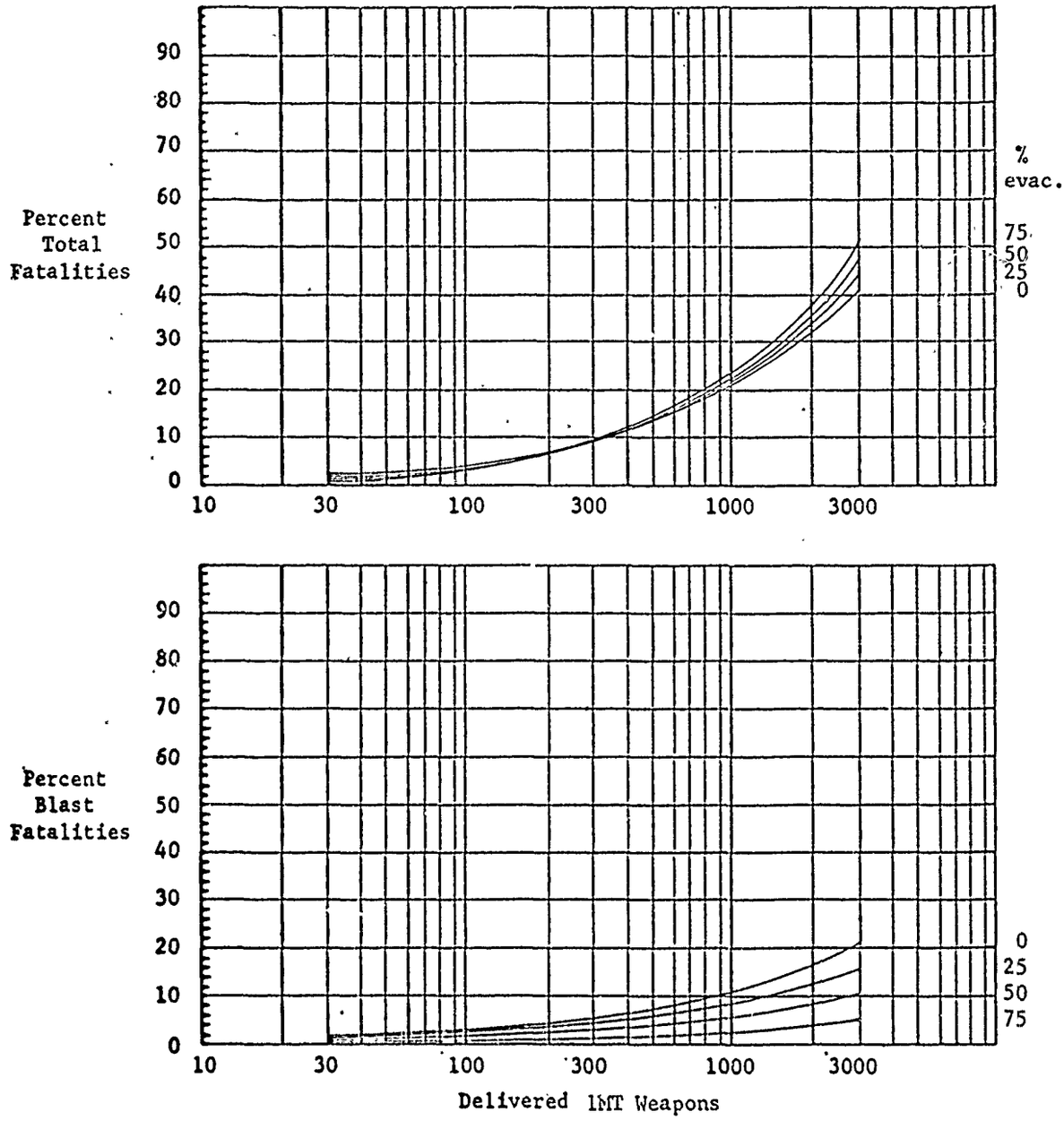


* Urban Shelter, 25 psi blast shelters; Rural Shelter, homes below ground.

Chart B-7

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 100 % at 50 PSI 1000 PF*
% at PSI PF
Rural 100 % at 2 PF

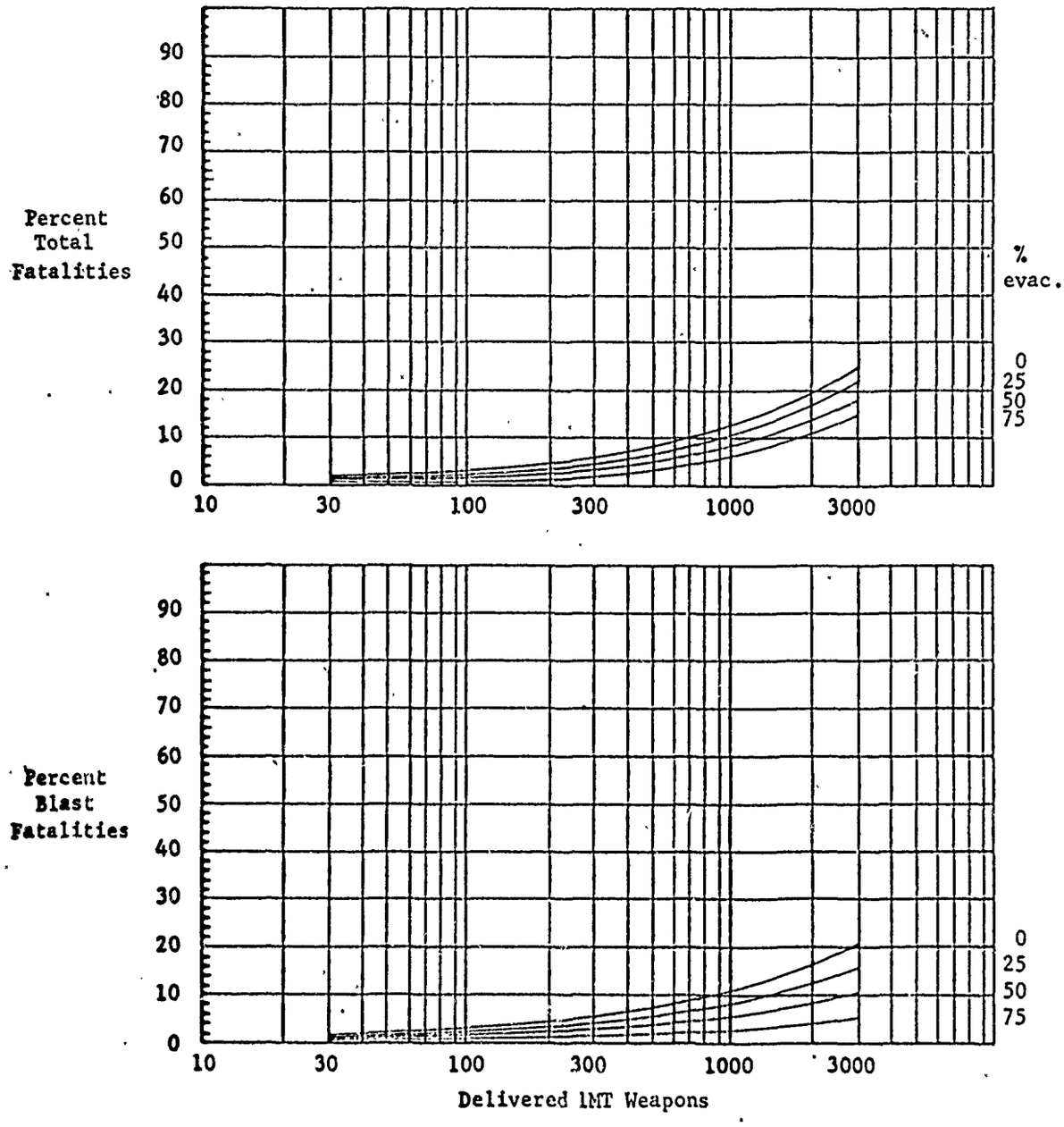


* Urban Shelter, 50 psi blast shelters; Rural Shelter, homes above ground.

Chart B-8

EFFECTS OF ATTACKS ON POPULATION

Shelter: Urban 100% at 50 PSI 1000 PF*
% at PSI PF
Rural 100% at 20 PF



* Urban Shelter, 50 psi blast shelters; Rural Shelter, homes below ground.

Appendix C

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
SYSTEM SCIENCES INCORPORATED Bethesda, Maryland	UNCLASSIFIED
	2b. GROUP N/A

3. REPORT TITLE

MOVEMENT AND SHELTER OPTIONS TO REDUCE POPULATION VULNERABILITY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

FINAL REPORT

5. AUTHOR(S) (First name, middle initial, last name)

EDGAR A. PARSONS

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
JANUARY 1970	123 plus Appendix	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	SSI-C-001-70
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Distribution limited to U.S. Gov't Agencies only; Classified References; 30 Nov. 1971. Other requests for this document must be referred to OSA, Office of Civil Defense, Research.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office of Civil Defense Office of the Secretary of the Army Washington, D. C. 20310

13. ABSTRACT

This report presents the case for movement and shelter options as an adjunct to CSP. The movement measure is to remove populations from potential blast areas of nuclear bursts. "Survival Plans" of the last decades are reviewed and various degrees of evacuation are analyzed. The conclusions are that if a 75% evacuation of a population at risk was possible in a crisis period and a PF of 20 could be arranged in reception areas, nearly 50 million people could be saved at a very minor fraction of the cost of blast shelters.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Security Classification

AD ACCESSION NO.
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Abstract Unclassified
SSI-C-001-70 -- Contract DAHC20-69-C-0139 -- OCD Work Unit 2313B

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